March 21, 1944. F. TURRETTINI 2,344,571

AXIAL BALANCE DEVICE

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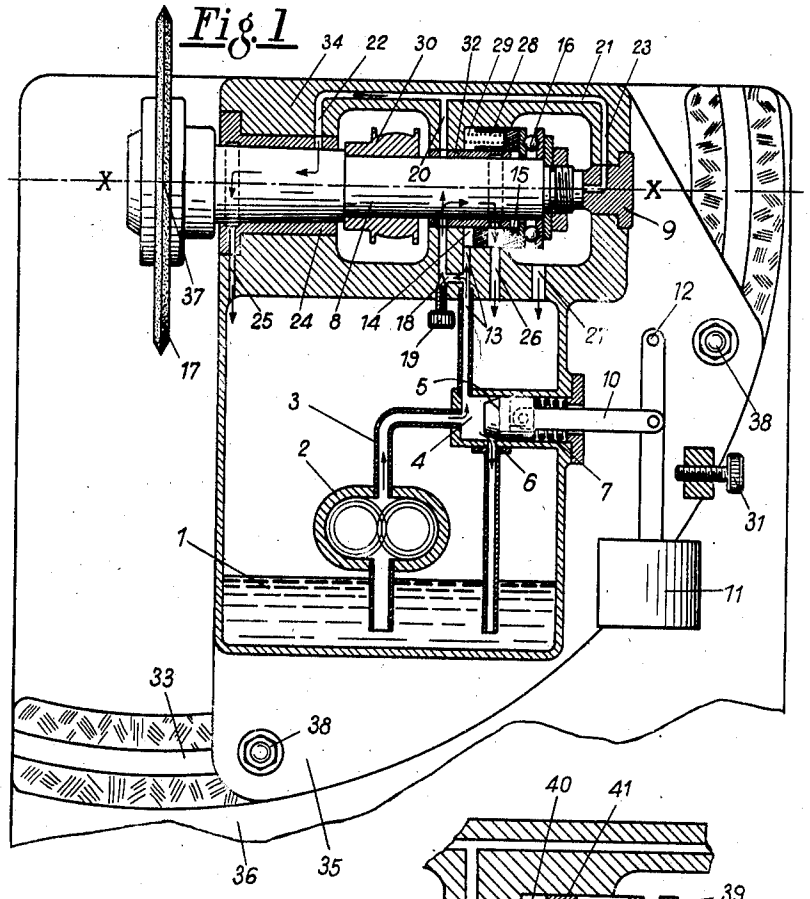
Fig. 1



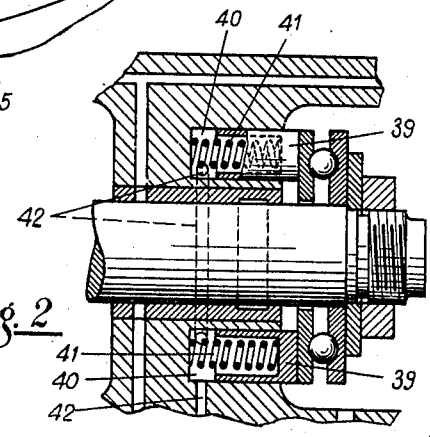


Fig. 2

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AXIAL BALANCE DEVICE

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7 Claims. (Cl. 308—9)

The object of the present invention is to provide an axial balance device for a body revolvable on an axis of variable inclination. This device is characterized by an axial abutment in the form of a thrust bearing, by a pump which, through the pressure of a fluid, applies the shaft of the body against this abutment, and by a regulator placed in the circuit of the pump and which regulates the pressure of the fluid according to the inclination of the shaft, the arrangement of parts acting in such a way that the force with which the shaft is applied against the abutment remains practically constant whatever may be the inclination, the variations of the effort exerted by the fluid compensating the variations of the axial component of the weight of the body.

The invention will be applied with advantage to grinding machines and especially to thread grinding machines, the above mentioned revolvable body being then constituted by the grinding wheel and its shaft.

It is known that in these machines the shaft of the grinding wheel must be inclined in accordance with the gradient of the helicoidal thread, in order that the rim of the grinding wheel may fit the winding of the thread.

It is also known that the grinding wheel of a machine of this type must have no axial play, in order to avoid inaccuracies in the thread to be ground.

It is impractical to suppress the longitudinal play of a shaft revolving at high speed by means of double acting adjustable thrust bearings, which can be clamped rigidly after their adjustment, because the expansion of the shaft during the course of the work results in a change of the initial adjustment, which must leave a space for a minimum film of lubricant. For this reason, one prefers to secure the longitudinal position of the shaft by means of a single acting thrust bearing, i. e., which absorbs the thrust in one direction only, and to realize the thrust by an elastic device, a spring, for instance, strong enough itself to resist to the reaction of the work-piece on the grinding wheel.

This kind of construction gives good results, in so far as the shaft of the grinding wheel only deviates slightly from the horizontal position, i. e., in the cases where the own weight of the grinding wheel and of its shaft does not influence exaggeratively, through its axial component, the thrust absorbed by the bearing. This thrust is always equal to the tension of the spring, plus or minus the axial component of the weight of the revolving parts, according to the angle of inclination of the shaft. This component tends to seat the shaft against the thrust bearing, or to separate them, with a force equal to the weight of the revolving masses multiplied by the sine of the angle of inclination measured from the horizontal.

When the angle of inclination becomes important, as it is the case for grinding wheels when dressing high pitch screw threads, the resulting thrust, received by the thrust bearing, changes too much in function of the inclination. Drawbacks result therefrom: The thrust becomes too strong when the grinding wheel happens to be higher than the thrust bearing, or too weak in the opposite case. In the first case, it produces a premature wear, in the second one, the reaction of the work-piece on the grinding wheel can give it an instable longitudinal position.

Applied to the above mentioned machines, the device according to the invention eliminates all these drawbacks, since it substitutes for the thrust of the spring that of a fluid, whose pressure varies inversely with the variations of the axial component of the weight of the revolving body.

The attached drawing represents, by way of example, an embodiment of the present invention constituted by a grinding machine intended for the dressing of screw threads, as well as an alternative.

Fig. 1 is a view, partly in elevation, partly in cross-section, of one embodiment; Fig. 2 shows a cross-section of an alternative form.

In Fig. 1, **17** is the grinding wheel and **8** its shaft, these two parts constituting a rotary body which revolves on the axis X—X; the shaft **8** is mounted in the bearings **24** and **32** of the housing **34** and bears at its end opposite the grinding wheel **17**, on a thrust bearing **9** of this housing, which bearing defines the axial position of the grinding wheel; the grinding wheel is rotated by the pulley **30**; the housing **34** is carried by a plate **35** able to be inclined on the base-plate **36**, its pivoting centre being at **37**, at the geometric centre of the grinding wheel; it is guided in its movement by a slide **33** in the base-plate, and can be fixed in any position by means of the bolts **38**. This movement of the plate **35** determines the inclination of the axis X—X, according to the pitch of the thread to be ground.

The housing **34** comprises a reservoir **1** that contains the fluid, which is an oil serving also as a lubricant. The oil is aspirated by a pump **2** and sent under pressure into a duct **3** leading to a pressure regulator **4** provided with a valve **5** able to open or to shut gradually an outlet duct

6, in order to vary the pressure in the regulator. The valve 5 is submitted to the action of a spring 7 serving to define the axial thrust, with which the grinding wheel shaft 8 must be pressed from left to right against the thrust bearing 9, and which must be sufficient to absorb the reaction of the work-piece on the grinding wheel 17.

The valve 5 is linked also by means of a rod 10 to a pendulum 11, pivoted at 12, which exerts on the valve 5 an effort of variable direction according to the inclination of the shaft 8, which effort is added to, or subtracted, from that exerted by the spring 7. The effort exerted by the pendulum on the valve 5 varies as the sine of the angle of inclination of the device. There will thus be maintained in the regulator 4 a pressure varying according to the inclination of the device, that will reach the recess 14 by the duct 13 and will act on a collar piston 15. The latter presses, through the intermediary of a thrust ball bearing 16, the end of the shaft 8 against the thrust bearing 9.

A shunt 18, the very small output of which is regulated by means of a needle valve 19, enables the fluid to flow in the lubrication circuit 20, which distributes the lubricant to the bearings 24 and 32, as well as to the thrust bearing 9, through the ducts 21, 22 and 23. The oil returns to the reservoir 1 through the return ducts 25, 26 and 27.

The collar piston 15 contains a number of springs 29 located in recessses 28 and which maintain the shaft 8 in contact with the thrust bearing 9 when the grinding wheel has been stopped and the pressure of the fluid is off. An adjustable stop 31, limiting the deviations of the pendulum 11 to the right, acts to prevent the pressure of the fluid from falling too low when the shaft of the grinding wheel is inclined very much to the right, i. e., when the thrust bearing 9 happens to be much lower than the centre of the grinding wheel 17.

In the alternative of Fig. 2, the collar piston 15 is replaced by cylindrical pistons 39, each one of which moves in a recess 40 of the housing and is submitted to the action of the pressure of the fluid coming in through the duct 42, and to the action of the spring 41.

It is well understood that the applications of the balance device according to the invention are not limited to the balance of a grinding wheel shaft. The pendulum regulator 11 can be replaced by any mechanical device exerting the same function under the combined action of its own weight and of its angular position in space.

I have now described the object of the invention in a manner to make it clear for those who are acquainted with the art.

What is claimed to be new is:

1. An axle balancing device of the character described including in combination a rotatable member, a housing therefor, provided with a recess about the rotatable member, a thrust bearing at the inner end of the housing bearing against the inner end of the rotatable member, another thrust bearing adjacent the inner ends of the rotatable member, pressure responsive means in the recess and acting on the last mentioned thrust bearing, a fluid reservoir carried with the housing, a fluid pump in the reservoir and in communication with the pressure responsive means, and a pressure regulator interposed in the communication between the pump and the pressure responsive means for regulating the pressure of the fluid on the pressure responsive means according to the inclination of the rotatable member.

2. An axle bearing device as claimed in claim 1, wherein a pendulum is provided and is operatively connected to the pressure regulator for controlling the position of the latter.

3. An axle bearing device as claimed in claim 1, wherein a pendulum is operatively connected to the pressure regulator and wherein the pressure regulator is in the form of a piston valve for controlling the amount of fluid passing through the communication between the pump and pressure applying means, a spring acting on the piston valve to hold the latter in a normal position and the pendulum acting to decrease or reinforce the action of the spring according to the angle of inclination of the housing.

4. An axle bearing device as claimed in claim 1, wherein a pendulum is operatively connected to the pressure regulator and wherein the pressure regulator is in the form of a piston valve for controlling the amount of fluid passing through the communication between the pump and pressure applying means, a spring acting on the piston valve to hold the latter in a normal position and the pendulum acting to decrease or reinforce the action of the spring according to the angle of inclination of the housing, and a stop for limiting the movement of the pendulum in the direction in which its action on the regulator decreases that of the spring in order to avoid that the pressure of the fluid on the pressure responsive means will become too weak.

5. An axle balancing device as claimed in claim 1, in which the pressure responsive means is in the form of a collar piston concentric with the rotatable member.

6. An axle balancing device as claimed in claim 1, in which the pressure responsive means includes at least two pistons disposed symmetrically with respect to the axis of the rotatable member.

7. An axle balancing device as claimed in claim 1, in which spaced bearings are provided in the housing for the rotary member, oil ducts in the housing communicating with the pump communicating means for lubricating the bearings and other ducts for returning the oil to the reservoir.

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