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AUTOMATIC BALANCING DEVICE FOR ROTORS OF PUMPS, TURBINES, BLOWERS, AND THE LIKE.

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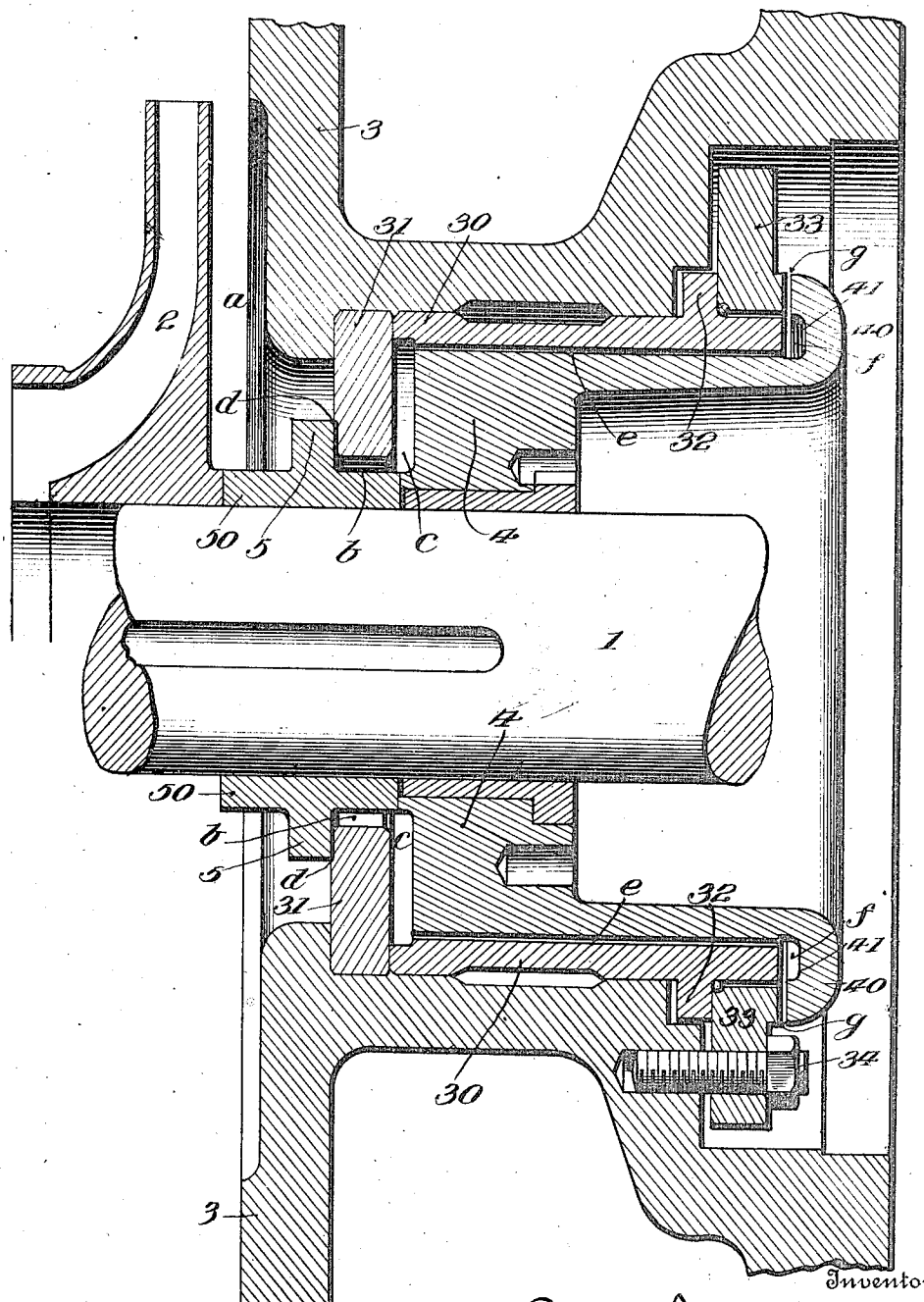

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AUTOMATIC BALANCING DEVICE FOR ROTORS OF PUMPS, TURBINES, BLOWERS, AND THE LIKE.

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To all whom it may concern:

Be it known that we, ARNO GRIESSMANN and OTTO GOTTSCHLING, subjects of the Emperor of Germany, residing at Berlin, Germany, have invented certain new and useful Improvements in Automatic Balancing Devices for Rotors of Pumps, Turbines, Blowers, and the Like, of which the following is a specification.

This invention relates to certain improvements in means for balancing the thrust in centrifugal pumps, turbines, blowers, and the like; and the objects and nature of the invention will be readily understood by those skilled in the art in the light of the following explanation of the accompanying drawings showing what we now consider to be the preferred embodiment from among other formations and arrangements within the spirit and scope of our invention.

The invention consists in certain novel features in construction and in combinations and arrangements as more fully and particularly specified and set forth hereinafter.

Referring to the accompanying drawings, the figure of the drawings is a longitudinal sectional view showing a portion of a pump, or the like, embodying our invention.

In the drawings, 1, is the axis or shaft of a rotor, such as the impeller system of a centrifugal or turbine pump or the like, embodying one or more runners, or impellers 2, inclosed within a suitable casing indicated by 3, and forming the internal or pump chamber *a*, containing liquid usually at the pump discharge pressure. In the drawings, we show the pressure or discharge end of the rotor and casing, and we preferably form said end of the casing to provide a cylinder concentric with the axis, to receive a balancing piston 4, fixed to and rotating with said axis and movable longitudinally therewith. This cylinder preferably receives an adjustable and removable cylinder lining or bushing 30, at its inner end abutting against a stationary circular annular plate 31, forming the end head of the cylinder and separating the same from the pump pressure chamber *a*, and formed with an enlarged central opening providing annular liquid passage *b*, around and longitudinally of the axis and at its outer end opening into the pressure chamber *c*, in the cylinder and between the opposing faces of the piston and the wall or plate 31.

We provide any suitable means to form a throttle fissure or passage between the chambers *a* and *c*, automatically controlled by the endwise longitudinal movement of the axis. In the specific example illustrated, we show a transversely arranged annular throttle fissure or passage *d*, from chamber *a*, to passage *b*, formed by the opposing parallel adjacent surfaces of the plate or wall 31, and an annular abutment 5, fixed to, projecting transversely from and movable longitudinally with the axis 1. This abutment, can, if so desired, be formed by an annular projecting flange in the chamber *a*, and adjacent the inner face of the wall 31, and rigid with a sleeve 50, fixed on the axis 1, between the piston 4, and impeller 2, and extending through the central opening of the wall 31.

In the specific example illustrated, we show the bushing 30, formed near its outer end with an external flange 32, against which a securing ring, 33, abuts, said ring surrounding the outer end of the bushing and being secured to the casing by suitable means, such as bolts 34, and holding the bushing inwardly and against the plate 31, although we do not wish to so limit the broad features of our invention.

To provide a pressure chamber and throttle fissure or outlet therefrom, at the outer end of the balancing piston, we can form or provide the outer end of the piston beyond the piston cylinder with an enlarged annular flange or head 40, having its annular inner side face opposing and arranged adjacent to suitable stationary surfaces of portions fixed to or forming parts of the casing to form the annular pressure chamber *f*, and the annular throttle fissure or outlet *g*, therefrom. If so desired, the pressure chamber *f*, can be formed between the outer edge wall of the bushing 30, and the recessed surface 41, of the enlarged end or head 40, of the piston and the fissure *g*, can be formed between the adjacent surface of ring 33, and the annular portion of the inner side face of the head 40, surrounding the surface 41.

The balancing piston is so fitted in its cylinder as to provide a narrow passage or sealing fissure *e*, between the periphery of the piston and the wall of the cylinder and extending longitudinally of the piston and through which liquid can leak or pass from the pressure chamber *c*, to the pressure chamber *f*. The balancing piston is preferably so proportioned as to slightly overbalance the thrust on the rotor toward the suction end of the pump and hence cause the rotor to normally tend to move toward the pressure end of the pump, and the parts are so arranged that the throttle passage from chamber *a*, to chamber *c*, will tend to normally maintain the rotor in balanced, intermediate or normal position with the throttle fissure *d*, of very small capacity or exceedingly contracted to maintain the necessary relative pressures in chambers *c* and *a*, to hold the rotor in said balanced position.

If the balance of the rotor should be so disturbed as to cause movement thereof toward the pressure side of the pump, beyond balanced position, the fissure *d*, is correspondingly reduced to reduce the flow of liquid to chamber *c*, and to thereby reduce the pressure on the piston in said chamber below that in chamber *a*, whereby the pressure in the pump casing toward the suction end of the pump will overcome the pressure on the piston and return the rotor to normal position.

If, for any reason, conditions should arise to overcome the normal overbalancing of the suction thrust by the piston, and permit movement of the rotor beyond balanced position and toward the suction end of the pump, the width and capacity of the throttle fissure *d*, will be correspondingly increased for free flow of liquid from chamber *a*, to chamber *c*, to maintain the pressure therein resisting movement of the piston toward the left. If for any reason, the leakage through sealing fissure *e*, should be excessive or too great to permit the formation of the necessary pressure in chamber *c*, to overcome the thrust toward the suction end of the pump, the continued movement to the left will then reduce the width of the throttle fissure *g*, sufficiently to raise the pressure in chamber *f*, to the extent necessary to act with the pressure in chamber *c*, in overcoming the suction thrust and to return the rotor to normal position.

The diameter and area of the surface of the piston head or flange exposed to the pressure in chmber *f*, is greater than the diameter and surface of the inner piston face exposed to the pressure in chamber *c*, and hence in the event of excessive thrust toward the suction end of the pump, the rotor will be returned to balanced position by the combined pressures in chamber *c*, *f*, acting in the same direction on the piston. This balancing action will be accomplished by the pressure in chamber *f*, even if through wear of parts an effective balancing pressure cannot be attained in chamber *c*.

It will be noted, that when the parts are in proper adjustment and normal or balanced position, the throttle fissure *g*, is of considerable capacity to avoid formation of effective pressure in chamber *f*, whereas fissure *d*, is of very slight capacity to permit formation of the desired balancing pressure in chamber *c*, and to automatically maintain proper balance of the rotor without such excessive movement as to reduce the capacity of throttle fissure *g*, and create effective pressure in chamber *f*, for the assistance of the pressure in chamber *c*. However, where the pump handles liquid containing much sand, grit or acid, the surfaces forming throttle fissure *d*, and particularly the surfaces of the piston and piston bushing are subjected to excessive wear and the proper adjustment of the parts and proportions of the passages and fissures are very apt to be thereby disturbed preventing the maintenance of the proper balancing pressure in chamber *c*, and permitting excessive leakage or flow through passage *e*, whereby the normal overbalancing of the suction thrust by the piston may be overcome permitting excessive thrust from right to left, that is, toward the suction end of the pump. It is then that the throttle fissure *g*, the chamber *f*, and the enlarged outer end of the piston come into play to maintain the proper balance of the rotor. Advantages, however, are attained, by providing the very narrow throttle fissure *d*, between the piston and impeller system, inasmuch as said fissure acts as a screen or filter in retaining the larger particles of grit or the like, which might tend to grind out the piston and piston bushing and the surfaces forming throttle fissure *g*, and furthermore, the surfaces forming throttle fissure *g*, are normally so widely separated as not to be subject to the excessive wear of grit and foreign matter. The piston is preferably removably secured to the shaft or axis, and the plate 31, which is subjected to the excessive wear of the grit and impurities can be not only reversible but is readily removable and renewable through the removal of the piston, and parts 33, and 30, hereinbefore described.

The longitudinal passage *b*, from the throttle fissure *d*, to the pressure chamber *c*, is preferably of fixed and excessive or considerably increased capacity with respect to the small capacity of said throttle fissure to prevent decrease in liquid pressure on account of the severe change in the direction of flow of the liquid in passing from said throttle fissure tc said longitudinal pas-

sage, as will be understood by those skilled in the art.

It is evident that various changes, variations, and modifications might be resorted to in the parts, arrangements and combinations described and hence we do not wish to limit ourselves to the exact disclosure hereof but consider ourselves entitled to all such changes, variations and modifications as fall within the spirit and scope of our invention defined by the claims.

What we claim is:—

1. Means for automatically balancing the end thrust of rotors, comprising a balancing piston on the rotor axis, and means providing a pressure-liquid passage embodying a pressure chamber at the inner face of the piston, a throttle fissure inlet thereto, a pressure chamber at the outer face of the piston having a throttle fissure outlet of increased capacity with respect to the capacity of said throttle fissure inlet, and a sealing fissure for the leakage of liquid from said inner pressure chamber to said outer pressure chamber.

2. Means for automatically balancing the end thrust of rotors in centrifugal pumps, turbines, blowers, and the like, comprising a balancing piston on the rotor axis, and a pressure-liquid passage from the pressure chamber of the pump to the outer face of the piston, said passage comprising a liquid pressure chamber at the inner face of the piston, a throttle fissure inlet thereto from the pump pressure chamber, a liquid pressure chamber at the outer face of the piston having a normally inactive throttle fissure outlet of normally excessive capacity with respect to the capacity of said fissure inlet, and a sealing fissure extending longitudinally and exteriorly of the piston for the leakage of liquid from said inner pressure chamber to said outer pressure chamber, said pressure chambers arranged so that the liquid therein will act on the piston in the same direction.

3. Means for automatically balancing the end thrust of the rotors of centrifugal pumps, turbines, blowers, and the like, comprising a balancing piston on the rotor axis having an outer face of greater diameter and area than the inner face of the piston and arranged to act longitudinally on the rotor in the same direction as the inner face, means providing liquid pressure chambers at said faces, a passage for flow of liquid from the inner pressure chamber to the outer pressure chamber, a throttle fissure inlet of reduced capacity to said inner pressure chamber, and a throttle fissure outlet from said outer pressure chamber and normally of excessive capacity to normally prevent formation of effective balancing pressure in said outer pressure chamber.

4. Means for automatically balancing the end thrust of the rotors of centrifugal pumps, turbines, blowers, and the like, comprising a balancing piston on the rotor axis having a liquid pressure chamber at its inner face, a throttle fissure inlet thereto from the pressure chamber of the pump, said piston provided with an enlarged annular outer end head providing an outer face of enlarged area, and having a liquid pressure chamber, a throttle fissure outlet from said outer pressure chamber normally of excessive capacity to not throttle the liquid in said outer pressure chamber, and a passage extending longitudinally and exteriorly of the piston for leakage of liquid from said inner to said outer pressure chamber.

5. Means for automatically balancing the rotors of centrifugal pumps, turbines, blowers, and the like, comprising a balancing piston on the rotor axis, a cylinder therefor providing a sealing fissure exteriorly and longitudinally thereof for leakage of liquid from the inner to the outer face of the piston, the inner face of said piston and said sealing fissure being so proportioned with respect to the rotor as to overbalance the suction thrust on the rotor, means providing an inner liquid pressure chamber at the inner face of the piston and a throttle fissure thereto from the pump chamber for automatically controlling the pressure in said inner pressure chamber with respect to the pressure in said pump chamber, to maintain the balance of the pump, and means providing a normally inactive pressure chamber at the outer face of the pump in communication with said sealing fissure and having a throttle fissure outlet of a normally excessive capacity.

6. Means for automatically balancing the rotors of centrifugal pumps, turbines, blowers, and the like, comprising a casing, a balancing piston on the pump axis having an enlarged annular outer end forming an inwardly facing outer annular face, a removable annular plate forming an inner pressure chamber in conjunction with the inner piston face and an annular longitudinal passage thereto, an abutment on the axis in conjunction with said plate forming a throttle fissure inlet to said passage, a removable piston bushing abutting said plate and forming a sealing fissure longitudinally of and around the piston periphery and in conjunction with said outer piston face forming an outer pressure chamber at said face, and a removable plate having securing means and abutting said bushing and in conjunction with said outer piston face forming a throttle fissure outlet from said outer pressure chamber.

7. Means for automatically balancing the rotors of centrifugal pumps, turbines, blowers, and the like, comprising a casing, a balancing piston on the pump axis, a removable

annular plate forming an inner pressure chamber in conjunction with the inner piston face and an annular longitudinal passage thereto, an abutment on the axis in conjunction with said plate forming a throttle fissure inlet to said passage, a removable piston bushing abutting said plate and forming a sealing fissure longitudinally of and around the piston periphery, and a removable plate having securing means and abutting said bushing.

In testimony whereof we affix our signatures in presence of two witnesses.

ARNO GRIESSMANN.
OTTO GOTTSCHLING.

Witnesses:
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