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ROTOR BALANCING MEANS

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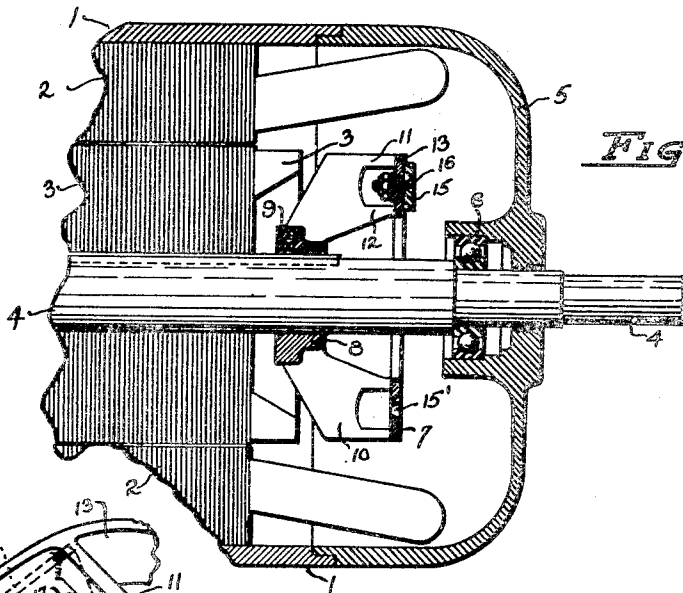


Fig. 1

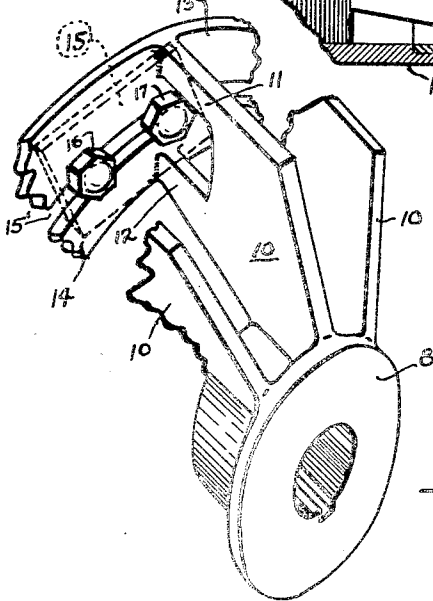


Fig. 3

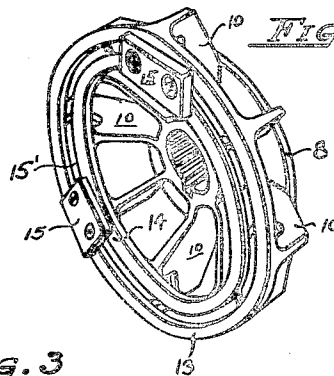


Fig. 2

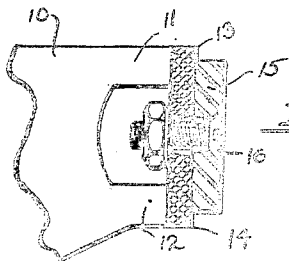


Fig. 4

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ROTOR BALANCING MEANS

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This invention pertains to means for balancing rotary bodies, and more particularly to a means for balancing, as a unit, the rotor and fan for a dynamo electric machine.

In the production of dynamo electric machines it is necessary to balance the rotating parts of the machine to eliminate excessive vibration. As machine tools and other equipment upon which machines of the present type are used, have improved in accuracy, it has become mandatory that the dynamo electric machines be substantially perfectly balanced to minimize distortion and inaccuracies caused by excessive vibration. While there have been numerous means proposed, and actually employed by which the rotors of dynamo electric machines may be balanced within the permissible limits, all of such means involve the use of relatively expensive equipment and additional structure in the machine itself, and are time consuming in adjustment.

Other means which are commonly used is the progressive removal of minute portions of material by filing, chipping or grinding, and particularly by drilling one or more holes of a size proportionate to the degree of unbalance. In lieu of removing metal from the rotating body, supplemental weight may be added to the lighter side of the body by applying solder or by otherwise attaching individual weights to the body. In either form, considerable time is consumed in the drilling of the body, or in providing means for attaching the additional weight at the desired location.

The present means for accomplishing the desired result is relatively inexpensive due to the small number and simplicity of the parts necessary, and is relatively easy to adjust, thereby eliminating the costly labor time necessary to adjust the prior balancing means.

The present disclosure contemplates the use of additional weights which are applied to the lighter side of the rotating body, but means are provided whereby the weights may be easily and quickly secured to the body in any desired location without the necessity of special preparation.

The object of the invention is to improve the construction, as well as the application and mode of operation of counterbalancing devices for rotary bodies, whereby they may not only be simplified in construction and operation, but may be economically manufactured, efficient in use, uniform in action, having relatively few parts and be unlikely to get out of repair.

A further object of the invention is to provide a dynamic balancing device which may be ad-

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justed through minute increments to add or subtract weight at a required point, thereby minimizing the time required for correcting an unbalanced condition.

A further object of the invention is to increase the accuracy of counterbalancing operations, and to provide a compact, unitary assembly which is permanently associated with the counterbalanced body, and secured in its adjusted position to maintain the balanced condition thereof.

A further object of the invention is to provide an adjustable counterbalancing weight which may be easily adjusted to any one of an infinite number of radial planes of the rotating body.

A further object of the invention is to provide an adjustable counterbalancing means having the advantageous structural features and inherent meritorious characteristics and mode of operation herein set forth, or their equivalents.

With the above primary and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation, as hereinafter described or illustrated in the accompanying drawings, or their equivalents.

In the drawings where is illustrated the preferred, but obviously not necessarily the only form of embodiment of the invention,

Fig. 1 is a fragmentary sectional view of an electric motor showing the balancing means in assembled position upon the rotor shaft.

Fig. 2 is a perspective view of the balancing means when removed from the rotor, looking from the right of Fig. 1.

Fig. 3 is a fragmentary perspective view of the balancing means when removed from the rotor, but on an enlarged scale and looking from the left of Fig. 1.

Fig. 4 is a detail sectional view showing the balancing weight attached to its support.

Like parts are indicated by similar characters of reference throughout the several views.

Present day production standards require precision work by both the machine tool and the operator. In order to maintain in the tool the required accuracy, not only must the expansion and contraction of the machine be controlled, but of equal importance is the control of machine vibration.

One of the contributory causes of machine vibration has been found to be the unbalanced condition of the power supply means, whether the machine be individually powered by an elec-

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tric motor, or belt driven through a series of pulleys. In view of the usually unbalanced condition of these rotating bodies, with a continuing demand for more precision by industry, it has become imperative that a means be provided for the rapid, efficient and accurate balancing of such bodies, without an appreciable increase in the cost of production.

The present unit has been designed to meet this requirement and while it is shown and described in connection with an electric motor rotor or armature, it is not limited to such specific application, but may be used in combination with other rotating bodies having a shaft or other rotating support upon which it may be mounted.

In the drawings 1 indicates the stator ring of a conventional electric motor, within which the stator coil 2 is mounted. Rotating within the stator coil 2 is the usual rotor 3 which is supported upon the rotor shaft 4. The conventional end bells or housing 5 enclose the ends of the stator ring 1, and furnish support for the bearing 6 within which the shaft 4 is supported. In most motors a fan 7 is also carried upon the shaft 4 adjacent the rotor body 3, to thereby cool the motor by causing a forced circulation of air therethrough. These parts are standard components of most all conventional motors.

The present balancing means utilizes the fan 7 as a support for the balancing weights, about the surface of which the weights may be secured in any desired position.

The present fan assembly includes a hub 8 which serves to mount the fan on the shaft 4 and is secured thereto by the set screw 9. Radiating from the hub 8 are a plurality of fan blades 10 which also project longitudinally of the unit in parallel relation with the rotor shaft 4. The longitudinal extremities of the fan blades 10 are bifurcated, thereby producing the furcations 11 and 12 on each of the blades 10.

The furcations 11 are united by an annular ring 13 and a second annular ring 14, located in inwardly spaced concentric relation with the ring 13, unite the furcations 12 on each of the blades 10. There is thus provided an annular slot 15' intermediate the two rings, through which the balancing weights are secured to the fan so as to permit universal adjustment thereof.

The present construction lends itself quite readily to casting as a means of production, and as shown in the drawings, the fan comprises a cast aluminum structure. The structure is equally adaptable however to fabrication by the use of individual stampings, which may then be united into an integral assembly by spot welding or other means.

Secured to the outer radial face of the fan formed by the two concentric rings 13 and 14 are the balance weights 15. Any number of these weights may be used, the number used being dependent upon the amount or degree of unbalance in the rotating assembly. The weights 15 are secured to the fan by the bolts 16 and 17 which prevent rotational movement of the weight relative to the fan. The bifurcated ends of the fan blades permit free passage of the bolts and attached weights circumferentially about the slot 15', providing universal adjustment of the weights. By this construction the weights may be located exactly opposite a fan blade if necessary for the proper balancing of the unit.

The weights may be produced in volume, and

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of varying masses so that a proper weight for a particular unit may be selected from a plurality thereof. The weight is then loosely secured to the fan and circumferentially adjusted thereabout until the proper location has been determined. When properly located so as to accurately balance the rotating unit, the bolts 16 and 17 are then tightened to permanently retain the weight in adjusted position.

By this construction the rotor 3, shaft 4, and fan 7 are balanced as a unit, and remain as a balanced unit until altered in some way. Such assembly has the advantage of eliminating at least one balancing operation in respect to what has heretofore been more or less common practice. The rotors 3 when assembled upon the shaft 4 have been balanced as a unit, the fans being separately balanced. Furthermore it is not uncommon under present practices, to re-balance the complete rotary unit after assembly of the fan upon the rotor shaft 4. A comparison of the multiple balancing operations as heretofore commonly performed with the single balancing operation permitted by the present construction clearly shows the ease and efficiency with which the balancing of rotor units may be accomplished with the present structure.

The present construction affords a further advantage in the overhauling or rebuilding of such units. If the rotor 3 be rewound, or otherwise altered, the previous balance is of course destroyed. With the present structure, the rewound rotor unit may be quickly and easily re-balanced, since the weights 15 may be readjusted to satisfy the requirements. The former methods of adding or subtracting material, left the rotor in a permanently mutilated or deformed condition, which deformities had to be balanced out in the re-balancing operation. As here shown, the original balancing of the unit in no way deforms the unit, and hence does not present a problem in the re-balancing of the unit after repairs. In effect, the repaired unit is re-balanced as though it were a new unit being balanced for the first time, the former balancing neither aggravating nor minimizing the unbalanced condition of the repaired rotor.

In lieu of using a single balance weight, it has been found advantageous to use two weights in the balancing of the rotary unit. Use of the two weights with differential adjustment thereof relative to the point of unbalance provides a minute adjustment of the effective mass applicable as a counterbalance for the rotary body. If two weights are used, such weights may be produced in large quantities, all weights being of the same mass. The weights are then assembled to the fan in a preliminary assembly operation, and when the balancing operation is performed, the weights need only be circumferentially adjusted by the operator. Removal of the nuts and bolts and substitution of different weights by the balancing operator is thereby completely obviated.

When using two weights to balance the unit, zero correction is obtained by placing the weights diametrically opposite each other, that is exactly 180 degrees apart. The amount of correction necessary to counterbalance the unit is then obtained by movement of the weights relative to the point of unbalance and relative to each other. By such movement, the effective counterbalancing mass which is applied to the unit can be very accurately adjusted, since movement of the weights relative to one another, adds to or

subtracts from the effective mass of the weights.

Such operation permits very accurate balancing of the rotary unit without the necessity of removing or adding mass to the unit, or the substitution of weights of different mass. Independent differential adjustment of the balancing weights results in the application of any desired mass as the counterbalancing influence. Movement of the weights relative to one another results in a progressively varying effective weight being applied to the unit. The two weights of equal mass, when moved relative to each other produce the same result as a plurality of weights of different mass, if applied individually to the unit until the proper mass was obtained. Weights of the same mass when properly adjusted produce the same results as the individual use of different weights of varying mass, without the inconvenience of selection, and assembly of different weights.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise the preferred form of several modes of putting the invention into effect, and the invention is therefore claimed in any of its form or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. Balancing means for a rotary body having a supporting shaft, including a fan mounted on said shaft, a plurality of radially projecting longitudinally overhanging blades therefor, bifurcations in the overhanging extremities of the fan blades, forming an outer and inner series of furcations concentrically disposed in relatively spaced relation, an annular ring secured to the outer series of furcations, a second annular ring secured to the inner series of furcations in relatively spaced concentric relation with the first annular ring, an annular slot formed therebetween, balance weights adjustably mounted upon the radial faces of the annular rings, and means for securing the weights in adjusted position, said means traversing the annular slot, the construction and arrangement being such that the weights may be circumferentially moved about the annular slot and secured in any desired position of adjustment.

2. Balancing means for a rotary body having a supporting shaft, including a fan mounted on said shaft, a plurality of radially extending blades therefor, bifurcations in the extremities thereof, a pair of annular rings secured to the blade extremities in relatively spaced relation, an annular slot formed therebetween the center of which coincides with the center of the bifurcations in the fan blades, balance weights angularly adjustable about the axis of the fan, and means for securing the weights to the fan including a plurality of studs carried by the weights and engageable within the annular slot and clamping means for securing the weights and

associated studs in adjusted position, the clamping means being free to shift to and fro through the bifurcations of the fan blades.

3. Balancing means for a rotary body having a supporting shaft, including a fan body, means for securing the fan on the shaft, a plurality of radially extending fan blades having recessed extremities, a plate secured to the fan blade extremities, an annular slot therein in aligned relation with the recesses in the fan blades, balancing weights adjustably mounted upon said plate and means traversing the annular slot for securing the weights in adjusted position, the construction and arrangement being such that the weights may be circularly adjusted about the shaft to different positions of angular adjustment relative thereto, the recessed fan blades permitting free passage of the securing means relative thereto.

4. Balancing means for a rotary body having a supporting shaft, comprising a supplemental rotary body secured to the shaft including a hub, a plurality of radial supporting members projecting therefrom and presenting approximately radial edges, a ring member secured to the supporting members on said edges, a balancing weight supported upon said ring member for relative sliding movement, and means for adjustably securing the weight in desired position upon the ring, the construction and arrangement being such that the weight may be freely adjusted throughout a complete circle concentric with the supporting shaft.

5. As an article of manufacture, a duo-functional fan and balancing member including a hub engageable with a rotary shaft, a weight carrying ring supported in concentric relatively spaced relation therewith, a plurality of fan blades interconnecting the hub and ring, a balance weight having a plurality of studs projecting therefrom supported upon said ring, a slot in said ring through which the studs project, means for securing the studs and associated weight in adjusted position upon the ring, and passages in the fan blades adjacent the ring through which the securing means are free to pass upon movement of the weight about the ring member.

6. As an article of manufacture, a duo-functional fan and balancing member including a hub engageable with a rotary shaft, a weight carrying ring supported in concentric relatively spaced relation therewith, a plurality of fan blades interconnecting the hub and ring and presenting approximately radial edges to which said ring is secured, a balance weight slidably mounted on the ring permitting circular adjustment of the weight to any one of an infinite number of positions about said ring, and means for securing the weight in adjusted position.

7. In a dynamo electric machine having a rotor and a supporting shaft, balancing means therefor including a fan mounted on said shaft independently of said rotor and having a plurality of radially extending blades, a ring secured thereto in concentric spaced relation with the shaft, balance weights supported on the ring and free to shift to and fro past the radially extending fan blades in a path concentric with the supporting shaft, and means for securing the weights in adjusted position upon the ring.

8. Balancing means for an electric motor rotor having a supporting rotary shaft, comprising a fan secured to the rotary shaft adjacent the rotor, a ring secured to the blades thereof in outwardly spaced concentric relation with the shaft, balance weights associated with said ring and

movable thereabout in a path concentric with the rotary shaft, means for clamping the weights in adjusted position upon the ring, and means permitting movement of the weights and associated clamping means to and fro past the fan blades.

9. In a dynamo electric machine having a rotor assembly comprising a rotor, a supporting shaft and a fan mounted upon said shaft adjacent said rotor, balancing means therefor including a ring member secured to the fan in outwardly spaced concentric relation with the supporting shaft, a balancing weight associated therewith, means for slidingly interengaging the balance weight with the ring for universal adjustment thereabout, and means for securing the balance weight in adjusted position upon the ring.

10. In a dynamo electric machine having a rotor assembly comprising a rotor, a supporting shaft and a fan mounted upon said shaft adjacent said rotor, means for balancing the assembly as a unit, including a ring member secured to the fan blades in concentric relative spaced relation with the supporting shaft, a balancing weight associated therewith and adjustable upon the ring in a path concentric with the supporting shaft, means for interengaging the balance weight with the ring and means for securing the weight in adjusted position, the construction and arrangement being such that the weight may be secured in any desired position of angular adjustment about the shaft even though such position coincide with one of the fan blades.

11. Balancing means for a rotary unit having a supporting shaft, including a plurality of weights, a support therefor carried by said shaft independently of said unit, about which support the

weights are universally adjustable in concentric relation with the supporting shaft, and means for securing the weights to the support, the construction and arrangement being such that the weights are individually adjustable relative to the support and to each other.

12. Balancing means for a rotary unit having a supporting shaft, including a plurality of weights, mounting means therefor comprising a permanent part of the unit and carried by said shaft independently of said unit, and means for securing the weights in individually adjusted position upon said mounting means, the construction and arrangement being such that the effective mass of the weights may be varied by adjustment thereof one relative to the other.

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