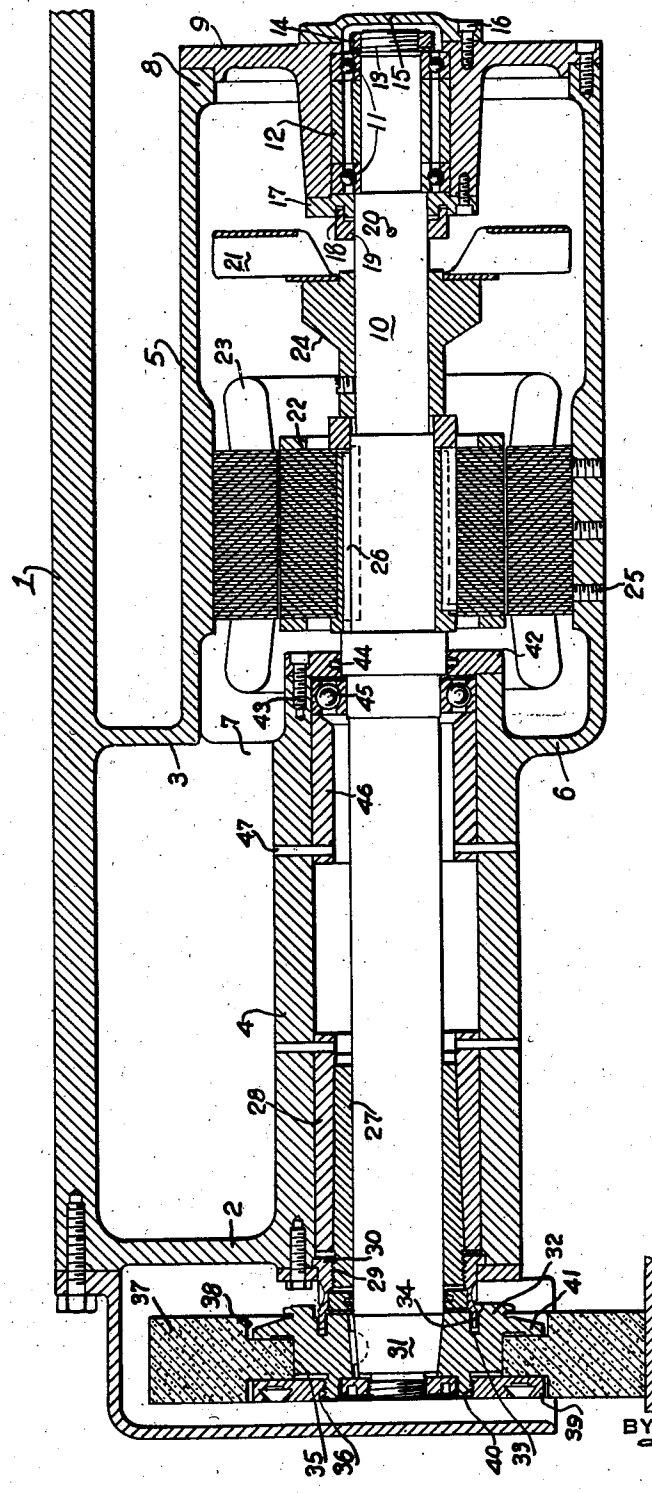
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SPINDLE SHAFT WITH INTERMEDIATE BALL BEARING

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SPINDLE SHAFT WITH INTERMEDIATE BALL BEARING

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The present invention relates to precision working tools and, more particularly, to machines for cutting, abrading, or finishing surfaces wherein a precision of dimension, spacing and angularity of the surface are required.

In the metal working arts the type of machines employed may be roughly divided into three classes, (1) rough working, (2) finish working with ordinary tolerances allowed, and (3) high precision machines in which the tolerances are practically zero. In the first group of machines may be placed certain types of heavy boring mills while the second type of machine may include practically all of the lathes, drill presses, shapers and rough planers. The present invention is concerned with the third group of these machines in which the requirements of precision working are so high as to place machines of this character in a class distinctly separate from all other types of metal working machines. These high precision machines are constituted almost entirely of grinders and the character of the work is to grind perfectly, flat surfaces to extremely close tolerances.

Many problems arise in connection with high precision grinders that are not present in connection with other machines in that the slightest misalignment of the rotating parts, including the shaft; the slightest chattering of the grinding wheel or the slightest wear at the bearings will definitely prevent such machine from performing its highly specialized and critical task. Considerable development work has been undertaken by the various manufacturers of precision grinders with a view to improving the character of the bearings so as readily and accurately to tighten up on the slightest wear, and careful attention has been paid to the matter of adjusting the thrust of the wheel. But even with the precautions brought about by this high state of development and research, minute movements of the wheel were still present which, while not being detectable by the eye nevertheless gave rise to imperfections in the finished surface such as to preclude unqualified acceptance of the work.

The primary object of the invention is to provide a grinding machine of the high precisional type in which the grinding wheel is caused to run absolutely true both in the radial and longitudinal directions in order that surfaces may be ground to the smallest allowable tolerances. This object is carried out in brief by extending the length of the grinder spindle, then journalling the ends of the shaft in proper bearings so that any slight misalignment of the bearing remote from the grinding wheel can have little or no effect on the rotational conditions of that portion of the shaft which is immediately adjacent the grinding wheel. The added length of the shaft permits the interposition of the driving motor between the bearings and any whip that is caused by the rotating parts of the motor is accommodated and completely prevented by the use of intermediate bearings positioned near the motor. By placing the motor intermediate the ends of the shaft no strains are set up within the shaft notwithstanding its considerable length and yet no whipping or other mechanical distorting effects are introduced anywhere along the shaft.

The invention will be better understood when reference is made to the following description and the accompanying drawing which shows in longitudinal cross section the improved structure by which a high precision grinding wheel can be satisfactorily mounted.

Reference character 1 designates a metal casting which may constitute part of the main frame of the machine. This casting is cored to leave several inwardly extending flanges 2, 3 in which the flange 2 carries a longitudinally extending tubular hub 4. The other flange 3 supports a fairly large cylindrical metal casing 5 which is connected at its inner end as indicated at 6 with the tubular hub 4. A plurality of spaced strengthening ribs 7 may be provided between the flanges or walls 2, 3 and secured along the outer edges to the frame 1 and at the inner edges to the tubular hub 4. The casing 5 is normally open and terminates in thickened portion 8. This end portion serves as a seat for a combined cover and hub or sleeve member 9 which contains the outer bearing. A multi-shouldered shaft 10 is carried at its outer end within the hub or sleeve member 9 by two sets of ball bearings separated by a spacer sleeve 12. The end of the shaft is threaded as indicated at 13 to receive a nut 14 which abuts the outer surface of the right hand ball bearing element 11. A cap 15 is screwed as indicated at 16, or in any other manner secured to the hub 9. The left hand set of ball bearings 11 are held in position by means of a screwed plate 17 which contains an annular groove 18 for rotatably receiving the flange extension of a collar 19 is set-screwed to the shaft as indicated at 20. To the left of the bearing described immediately above there is mounted on the shaft a fan 21 for causing cool air to be driven longitudinally of the shaft through a

motor. The armature of the motor is indicated at 22 and the field at 23, this armature abutting a heavy hub piece 24. The field of the motor is secured to the cylinder 5 by means of screws 25 and the armature of the motor is keyed to the shaft as indicated at 26.

The grinding wheel end of the shaft 10 is journalled in an ordinary tapered sleeve bearing, the sleeve being designated at 27. Immediately surrounding the sleeve there is a liner which fits snugly within the tubular housing, 4. This liner may be pinned or otherwise secured to the housing to prevent rotation. The sleeve 27 is threaded at the left hand end as indicated at 29 for receiving a cylindrical nut 30 which serves to move the sleeve 27 longitudinally with respect to the shaft. The sleeve is of a split character so that a movement to the right will cause a tighter fit between both halves of the sleeve and the shaft.

The shaft 10 is provided at its grinding wheel end with a tapered portion indicated at 31 into which is keyed a wheel backing plate 32 of any suitable and well known type. The backing plate is provided with a groove 33 which is adapted to receive an annular extension 34 on the cylindrical nut 29. The backing member 32 is provided with a pair of step-down shoulders indicated at 35 and 36 respectively, the former of which serves as a seat for a grinding wheel 37. The latter is shouldered as indicated at 38, this shoulder being in line with the shoulder formed between the two step-down portions of the backing plate 32 so as to provide an annular recess for receiving a clamp ring 39. The interior bore of the ring is threaded at 40 to engage threads on the shoulder 36. The backing member 32 is provided with a circular ledge 41 against which the wheel may be cause to bear when the clamp ring is screwed on the backing plate.

It is apparent from the drawing that the shaft 10 is of considerable length in order to provide a long overhanging effect between the wheel 37 and certain parts of the frame member. The heavy armature 22 of the motor is carried by the shaft and it is evident that there may be a considerable whipping effect at the middle of the shaft due to its long length. This effect obviously causes undue wear at the sleeve bearing 27 and eventual wobble of the wheel 37 with consequent poor quality of work. In extreme cases the sleeve bearing might be seriously damaged under these circumstances calling for an early replacement thereof. In order to avoid the possibility of a whipping action, the prior art has consistently avoided placing the motor at a position intermediate the bearings, but instead, the shaft 10 has been extended beyond the right hand bearing and a coupling, usually of a flexible character, is attached to the driving motor.

In accordance with the principles of the present invention an improved support structure is provided which permits positioning of the driving motor between the bearings and still prevents any whipping or other distortional effects on the grinding wheel due to this motor position. The improved structure includes an additional journal of the ball bearing type so arranged that the support for the additional bearing may be made integral with the support for the other bearings. Thus, the tubular hub 4 is extended to the right of the sleeve bearing 27 almost as far as the armature 22 of the motor. A cover plate 42 is screwed onto the right hand end of the tubular hub as indicated at 43. The plate 42 is provided with an annular recess 44 for receiving an oil seal packing which directly contacts with the shaft. The plate 42 provides a wall against which a ball bearing device 45 may be pressed by means of a sleeve 46 which is pinned as at 47 to the hub 4. The sleeve 46 has an outer diameter as snugly to fit the housing 4 and an inner diameter considerably greater than the diameter of the shaft as can be seen on the drawing. The inner race of the ball bearing device 45 is secured in any suitable manner to the shaft while the outer race is held rigidly in a stationary position by the clamping effect exerted by the sleeve 46.

It is evident that the ball bearing device 45 is positioned quite close to the heavy armature and provides a good support therefor. By mounting the ball bearing on an extension of the tubular housing 4 economy of construction is effected since the bearing support may be cast integral with the remainder of the frame. It is apparent that due to the improved position of the motor the latter is given considerable protection against externally applied damage because the casing 5 serves as a substantial shield, and yet the motor can be adequately cooled by the fan 21.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims and the invention.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a grinding machine, a frame, a shaft, main bearings carried by said frame and rotatably supporting said shaft adjacent the ends thereof, a grinding wheel fixed to one end of said shaft, a tubular hub integral with said frame and loosely surrounding said shaft from the grinding wheel and inwardly to a point approximately midway of said shaft, a motor having its stator carried by said frame and having its rotor fixed to said shaft externally of but loosely adjacent the inner end of said hub, an intermediate bearing mounted in the inner end of said hub and rotatably supporting said shaft closely adjacent to said rotor, and means positioned between the grinding wheel and hub for tightening the main bearing nearer to said wheel.

2. In a grinding machine, a frame, a tubular hub integral with said frame, a casing integral with said frame having an axis coincidental with the axis of said hub and of larger size than said hub, said hub and casing overlapping at their inner ends for a fraction of their lengths, a sleeve bearing mounted in the outer end of said hub and a ball bearing mounted in the casing remote from said sleeve bearing, a shaft rotatably mounted in said bearings, a grinding wheel on the end of said shaft adjacent the outer end of said hub, a motor having its stator fixed in said casing and its rotor on said shaft, an intermediate bearing supporting said shaft at the inner end of said hub closely adjacent said rotor, and means whereby said sleeve bearing can be adjusted from the exterior of said casing while all the parts of the machine, including the grinding wheel, remain in position.

3. In a grinding machine, a frame, a tubular hub integral with said frame, a casing integral with said frame having an axis coincidental with the axis of said hub and of larger size than said hub, said hub and casing overlapping at their inner ends for a fraction of their lengths, a sleeve bearing mounted in the outer end of said hub and

a ball bearing mounted in the casing remote from said sleeve bearing, a shaft rotatably mounted in said bearings, a grinding wheel on the end of said shaft adjacent the outer end of said hub, a motor having its stator fixed in said casing and its rotor on said shaft, an intermediate ball bearing supporting said shaft at the inner end of said hub closely adjacent said rotor, said sleeve bearing being adapted to be adjusted from the exterior of said casing.

4. In a grinding machine, a frame, a tubular hub integral with said frame, a casing integral with said frame having an axis coincidental with the axis of said hub and of larger size than said hub, said hub and casing overlapping at their inner ends for a fraction of their lengths, a sleeve bearing mounted in the outer end of said hub and a ball bearing mounted in the casing remote from said sleeve bearing, a shaft rotatably mounted in said bearings, a grinding wheel on the end of said shaft adjacent the outer end of said hub, a motor having its stator fixed in said casing and its rotor on said shaft, an intermediate bearing supporting said shaft at the inner end of said hub closely adjacent said rotor, and means mounted on said casing between the grinding wheel at the end of said casing for tightening said sleeve bearing from the exterior of said casing while all the parts of the machine, including the grinding wheel, remain in position.

5. In a grinding machine, a frame, a tubular hub integral with said frame, a casing integral with said frame having an axis coincidental with the axis of said hub and of larger size than said hub, said hub and casing overlapping at their inner ends for a fraction of their lengths, a sleeve bearing mounted in the outer end of said hub and a ball bearing mounted in the casing remote from said sleeve bearing, a shaft rotatably mounted in said bearings, a grinding wheel on the end of said shaft adjacent the outer end of said hub, a motor having its stator fixed in said casing and its rotor on said shaft, an intermediate bearing supporting said shaft at the inner end of said hub closely adjacent said rotor, means mounted on said casing between the grinding wheel at the end of said casing for tightening said sleeve bearing from the exterior of said casing while all the parts of the machine, including the grinding wheel, remain in position, a fan hub fixedly mounted on said shaft adjacent said rotor and on the opposite side thereof relative to said intermediate bearing, and a fan fixedly mounted on said hub, said intermediate bearing and said fan hub and said fan serving to prevent lateral movement of said shaft.

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