Feb. 24, 1970 A. A. HUTCHINS 3,496,680

POWERED REVOLVING ABRASIVE TOOL

Filed Aug. 18, 1967

Fig. 1

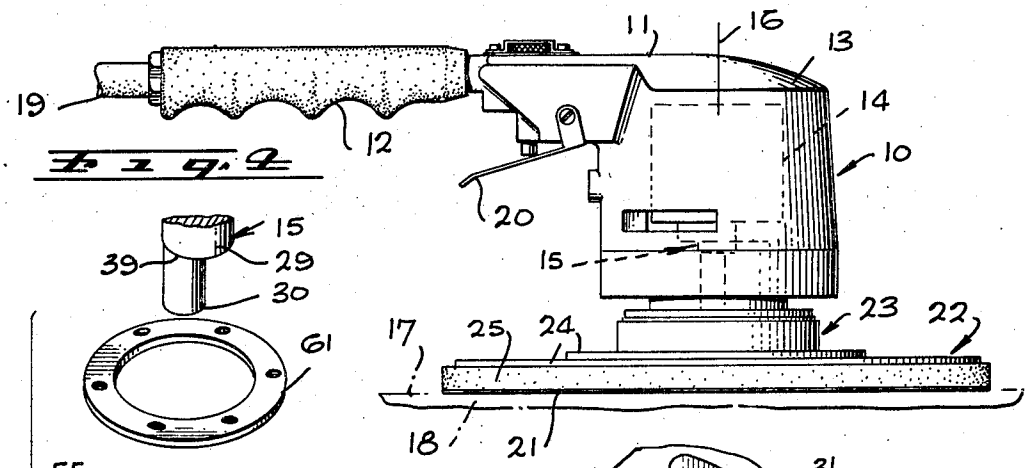


Fig. 4

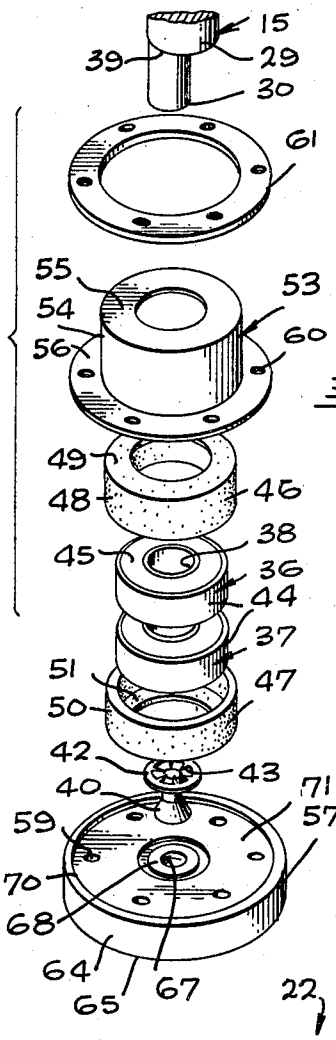
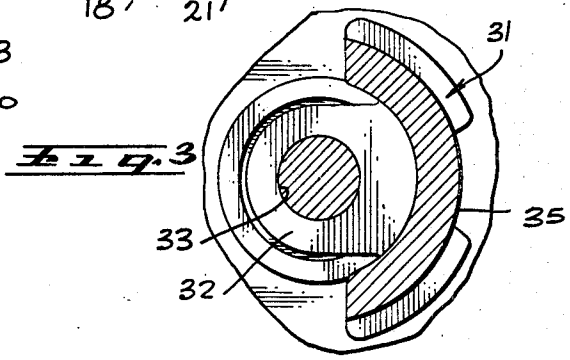


Fig. 3



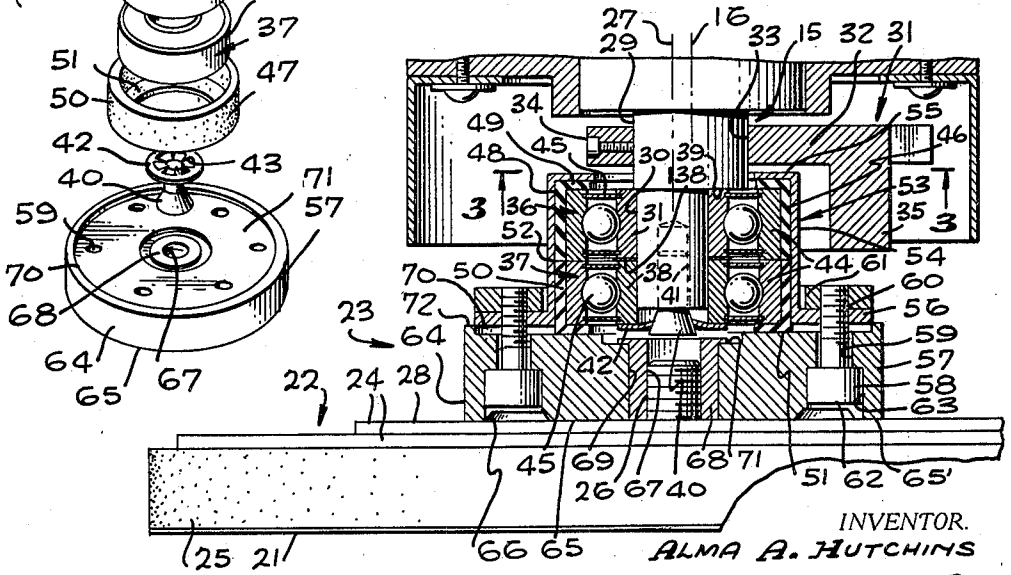


Fig. 2

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United States Patent Office 3,496,680 Patented Feb. 24, 1970

3,496,680

POWERED REVOLING ABRASIVE TOOL

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Filed Aug. 18, 1967, Ser. No. 661,593
Int. Cl. B24b 23/02
U.S. Cl. 51—170 14 Claims

ABSTRACT OF THE DISCLOSURE

A powered sanding tool having a removable backing pad for carrying an abrasive disc, with the backing pad being detachably connectible to a structure mounted for rotation about an eccentric portion of the shaft of the driving motor. This structure is mounted for rotation about the offset axis of the eccentric portion of the shaft by bearings disposed about that portion of the shaft, with the mentioned structure including a housing disposed about the bearings and carrying a forward wall at the front of the bearings to the center of which the pad is mounted, and with this wall engaging the pad far enough outwardly from its center to effectively support and locate the pad in operation.

BACKGROUND OF THE INVENTION

This invention relates to powered tools for carrying and driving abrasive discs, such as sandpaper discs, for abrading the surface of a workpiece.

There have in the past been proposed sanding tools in which an abrasive disc, instead of being driven rotatively about its own axis, is revolved bodily about an offset axis, to attain an improved type of sanding action. However, the prior units of this type with which I am familiar have in practice had certain definite disadvantages, by reason of the fact that the manner in which their revolving motion has been attained has inherently resulted in an ineffective and unreliable mounting of the disc and its backing pad to the driving portion of the tool. More particularly, in providing a bearing assembly capable of mounting the pad and disc for the desired revolving movement, an arrangement has been utilized in which the pad is connected to and located by the carrying structure at only a very central portion of the pad, with the result that forces exerted against the periphery of the pad in use have had a tendency to break or damage the pad, and to necessitate its frequent replacement. Further, the structural arrangement heretofore employed in devices of this type has been such as to inherently limit the size of the bearings which could be utilized in mounting the backing pad for its revolving motion, to thus further reduce the effectiveness of the pad mounting.

SUMMARY OF THE INVENTION

A device embodying the present invention is constructed to produce the above discussed revolving type of motion of an abrasive disc, but without the mentioned inadequacies of the prior art arrangements. More specifically, a tool embodying the invention mounts the disc backing pad much more rigidly and effectively to the driving head of the device, and supports the backing pad over a relatively large area at locations extending radially outwardly a substantial distance from the center of the pad. Thus, even though forces of very substantial magnitude are exerted against the periphery of the pad, the pad is effectively backed up by the mounting head in a manner resisting those forces and preventing damage to or destruction of the pad or any of its components as a result of those forces. Additionally, the unique arrangement for mounting the backing pad and its carried sanding disc is such as to enable the use of bearings of considerably increased size as compared with prior sanding devices, to thereby enhance the mounting of the pad and further resist the forces encountered in use.

To attain these results, I provide a motor having a driven shaft which turns about a first axis, and having an eccentric portion of the shaft about which a bearing or bearings are mounted, with these bearings in turn mounting a pad carrying structure for rotation about the eccentric axis. This structure has a first portion disposed about the bearing or bearings, and a second and forward portion to which the pad is detachably connectible. Preferably, this detachable retention of the pad is effected by internal threads formed in the forward portion of the pad carrying structure, and engageable with an externally threaded shank projecting rearwardly from the pad. The pad carrying structure is desirably cushioned by rubber or other elastomeric material for limited resilient movement relative to the bearings. The two portions of the pad carrying structure may be connected together by appropriate fasteners, desirable located radially outwardly beyond the maximum diameter of the bearings. Also, the bearings may be retained on the eccentric portion of the shaft by a fastener which is accessible for tightening or removal through the internal threads to which the backing pad is connectible.

BRIEF DESCRIPTION OF THE DRAWING

The above and other features and objects of the invention will be better understood from the following detailed description of the typical embodiment illustrated in the accompanying drawing, in which:

FIG. 1 is a side view of a powered revolving sanding tool constructed in accordance with the invention;

FIG. 2 is an enlarged fragmentary axial section through a portion of the FIG. 1 tool;

FIG. 3 is a reduced fragmentary transverse section taken on line 3—3 of FIG. 2; and

FIG. 4 is an exploded perspective representation of the various parts forming the pad mounting head of the device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1, I have shown at **10** a revovling type disc sander constructed in accordance with the invention, and including a main body **11** having a handle portion **12** by which a user holds the tool in use. Body **11** also has an enlarged portion **13** containing a rotary motor **14** whose driven shaft **15** turns about a main axis **16** of the device. In the position in which the tool is illustrated in the figures, axis **16** of the motor extends vertically, and perpendicular to the surface **17** of a workpiece **18** which is to be sanded. Motor **14** may typically be a pneumatically driven rotary motor, powered by compressed air supplied to the motor through a hose **19** connected into an air feed passage in the handle of the device. Suitable valve means are of course provided for starting and stopping the motor, such as an appropriate valve connected into the forward portion of the handle and actuable by a control trigger **20**.

The actual sanding operation is performed by a conventional circular sandpaper disc **21** (FIGS. 1 and 2), which is carried by a backing pad assembly **22** detachably secured to a revolving driving head **23** of the tool. Pad **22** may consist of two circular concentric rigid backing plates **24**, typically formed of a rigid resinous plastic material or the like, and carrying a circular cushion **25** of rubber or other desirably elastomeric material. Plates **24** rigidly carry a screw having an externally threaded shank **26** (FIG. 2) which projects from the rear side of the pad **22** perpendicular to sandpaper disc **21**, plates **24**, and cushion

25. When attached to driving head 23, shank 26 and its external threads are centered about an axis 27 which extends parallel to but is offset laterally from main axis 16 of motor 14. Parts 21, 24 and 25 are all disposed transversely of this axis 27, and are all centered about that axis to give the backing pad 22 and its carried sandpaper disc 21 a symmetric circular configuration with respect to that axis. It is also noted that the rearmost or uppermost one of the two backing plates 24 has a surface 28 at its rear side which is planar and which is disposed transversely of axis 27, and which as will appear later is engageable with driving head 23 in backing and locating relation.

The shaft 15 of motor 14 is rigidly connected to the rotor of that motor, and as best seen in FIG. 2 has a main portion 29 which may be of externally cylindrical configuration and is centered about main axis 16 of the motor. Downwardly beyond its portion 29, shaft 15 has a reduced diameter eccentric portion 30, which may also be externally cylindrical, and is centered about the mentioned axis 27, which is parallel to but offset from axis 16. Head 23 is mounted to and revolves with eccentric portion 30 of the shaft. To counterbalance the revolving motion of head 23 and its carried pad 22, portion 29 of the shaft may carry a counterweight 31, having a mounting portion 32 which contains an opening 33 within which portion 29 of the shaft is received. The counterweight 31 may be secured rigidly to portion 29 of the shaft by a set screw 34 tightenable against the shaft. Portion 35 of the counterweight is offset from axis 16 in a direction diametrically opposite the direction in which axis 27 is offset, and is of an appropriate effective weight to exactly counterbalance the head 23 and its carried parts when the device is in operation. To conserve space, the weight portion 35 of the device may be arcuate about axis 16, and be received about an upper portion of head 23.

The head 23 includes a pair of bearings 36 and 37 which are disposed about eccentric portion 30 of the motor shaft, and which are preferably ball or roller bearings, or their equivalent. That is, these bearings 36 and 37 are of the type having a circular series of rolling elements interposed between two races and extending about axis 27. The inner races of the bearings 36 and 37 are designated 38 in FIG. 2, and have inner cylindrical surfaces which are a tight pressed fit on the outer surface of eccentric portion 30 of the shaft. The upper one of these two races is engageable against the shoulder 39 formed at the juncture of the main portion 29 and eccentric portion 30 of the shaft. The two bearings are tightened upwardly against shoulder 39 by a screw 40 which is connected into an internally threaded bore 41 in eccentric portion 30 of the shaft, and whose head bears upwardly against the inner edge of a retaining ring 42, whose outer edge portion bears annularly and upwardly against one of the races 38 of the bearings. Preferably, ring 42 is of the lock washer type, having at its inner edge a series of radially inwardly projecting angularly turned lugs or fingers 43 which engage head 40 in a manner locking that head against unscrewing rotation. The outer races of bearings 36 and 37 are designated 44 in FIG. 2, with the bearing balls 45 being received radially between the two races in conventional manner. For best results, the bearings 36 and 37 are of the sealed type, having essentially annular end plates 45 retaining lubricant within the bearings and preventing access of foreign materials to the interior of the bearings. The outer races 44 of the two bearings are preferably in direct engagement with one another. However, the inner races are desirably spaced slightly apart by an annular shim 138, of a thickness just compensating for the usual slight axial overhang of the outer race of such a bearing relative to its inner race.

About the externally cylindrical outer surfaces of outer races 44 of the bearings, there are provided two cushioning elements 46 and 47, which may be identical but inverted with respect to one another. These elements are formed of a resiliently deformable elastomeric material, such as neoprene or another type of rubber capable of withstanding the conditions encountered in use. Cushioning element 46 has a main internally and evternally cylindrical axially extending portion 48 which is centered about axis 27, and whose internal diameter corresponds to the external diameter of outer race 44 of the associated bearing 36, to form a sleeve encircling that bearing. At its upper end, cushion element 46 has a radially inturned transverse flange portion 49, which engages against the transverse end surface of outer race 44 of bearing 36. Similarly, cushion element 47 has an axially extending internally and externally cylindrical main portion 50 received about the outer race of bearing 37, and a transverse inturned annular flange 51 engaging the lower end of that race. The two cushion elements may engage one another annularly at 52, in the same transverse plane in which the inner and outer races of the two bearings contact one another.

Disposed about cushioning elements 46 and 47, there is provided an annular rigid housing part 53, desirably formed of a rigid sheet metal, such as steel, and having an internally and externally cylindrical portion 54 which fits closely about and effectively confines cushion elements 46 and 47 along almost their entire axial extent. At its upper end, housing element 53 has a radially inturned transverse flange 55, which engages the transverse end surface of cushion element 46, to confine that cushion element against upward axial movement. At its lower end, housing part 53 has a radially outwardly turned annular rigid flange 56, disposed directly transversely of axis 27, and of course centered thereabout. This flange is secured to a relatively thick circular pad carrying transverse wall 57, also formed of a suitable rigid metal, desirably an aluminum alloy. To secure wall 57 to flange 56, there are provided a series of evenly circularly spaced screws 58, extending upwardly through openings 59 in wall 57 and through openings 60 in flange 56, and connecting threadedly into openings in an annular retaining ring 61 egaging the upper side of flange 56. The heads 62 of screws 58 are received within enlarged counterbores 63 in the under or forward side of wall 57. The tightening of screws 58 is limited by confinement of the flange 51 of cushion element 47 between the upper surface of wall 57 and the outer race 44 of bearing 37. Thus, the entire structure consisting of housing part 53, wall 57, screws 58, and ring 61 is mounted for rotation about axis 27 of eccentric portion 30 of the shaft, and yet is cushioned with respect to its mounting bearings 36 and 37 and the shaft by the parts 46 and 47. This cushioning action enables very slight movement of the housing 53 and associated parts both radially and axially relative to the motor shaft. It should also be pointed out that the tightness of the fit between the outer housing 53 and its associated parts and the outer races 44 of the bearings is sufficient to effectively retain housing 53 and its connected parts frictionally against rotation relative to the outer races 44 of the bearings.

Wall 57 is externally circular, and specifically may have an outer cylindrical surface 64 centered about axis 27. The lower or forward surface 65 of wall 57 is adapted to engage upper surface 28 of backing plate 24 of pad 22 in backing relation. This surface 65 may be interrupted at the location of an annular groove 66 formed in wall 57 near its periphery, but with a radially outer portion 65' of surface 65 being provided at essentially the periphery of wall 57, to engage and back up plate 24 annularly at a location which is a very substantial distance radially outwardly from axis 27, preferably at least about three-fourths of an inch, and for best results between about three-fourths and two inches from the axis. Surface 65 and its outer portion 65' are annular and disposed essentially transversely of axis 27; but preferably are not exactly planar, in order to facilitate removal of the pad from head 23. More particularly surface 65, as viewed in FIG. 2, is desirably inclined slightly to advance gradually and progressively upwardly as it advances radially in-

wardly from edge portion 65' toward axis 27. This progressive upward or rearward axial advancement is preferably so slight as to be incapable of representative in FIG. 2, and for example may for best results be between about .010 and .0625 of an inch from the outermost portion of surface 65 to its innermost portion (or at an angle of between about one-fourth of a degree and one degree to a transverse plane, desirably about one-half of a degree). By virtue of this slightly frusto-conical shape of surface 65, I assure that the tightest engagement between this surface and the planar surface 28 of plate 24 will be at the periphery 65' of surface 65, so that the rest of surface 65 will not bind with respect to surface 28 in a manner frictionally preventing easy removal of the pad. At the same time, however, when the pad is screwed onto head 23, the pad may be tightened to a condition in which, after peripheral surface area 65' has engaged surface 28, further tightening causes the plate 24 which carries surface 28 to be resiliently deformed very slightly upwardly to a condition in which the central portion of surface 28 is of the same slightly frusto-conical shape as surface 65, and therefore continuously engages and is effectively backed up by surface 65.

At its center, circular wall 57 carries internal threads 67 which are centered about axis 27 and are adapted to removably receive and engage the external threads of shank 26 projecting from pad 22. These internal threads 67 may be formed directly in the material of wall 57, or may be formed by a tubular threaded insert 68, which is a pressed fit within an appropriate opening 69 in wall 57, with the insert being rigidly retained against any type of motion relative to wall 57. The upper surface 70 of wall 57 may be disposed transversely of axis 27, but with an annular recess being formed at 71 at its inner edge, and an annular flange 72 being formed at the outer edge of that surface.

In using the tool, the pad 22 is of course normally retained in the illustrated assembled relation with respect to driving head 23 (see FIGS. 1 and 2), by reception of shank 26 within threaded opening 67. Sandpaper disc 21 may be adhesively secured to the under or forward surface of element 25, and the trigger 20 may then be actuated to commence powered movement of the pad 22 and disc 21. As the shaft 15 of motor 14 turns about axis 16, the eccentric portion 30 of the shaft causes the entire carried head 23, including housing 53, wall 57, and the associated parts, to revolve bodily about axis 16. At the same time, bearings 36 and 37 allow free rotation of this revolving structure about eccentric portion 30 of the shaft, so that backing pad 22 and the sandpaper disc 21 both revolve about axis 16, but are not driven rotatively about the offset axis 27. Because wall 57 engages backing plate surface 28 about the threaded opening 67, and especially at the peripheral region 65' of FIG. 2, the pad 22 is very effectively retained against cocking movement relative to axis 27 and the carrying head 23. Thus, the tendency heretofore encountered in devices of this general type to damage the backing plates 24 by virtue of their very localized retention at only the center of the pad is avoided, and the useful life of the pad is greatly increased. Also, the sanding action attained by this very effectively backed arrangement is far superior to that attained with the prior devices. Additionally, the discussed arrangement of parts enables the use of a bearing structure of much greater size than has been possible heretofore, so that the two bearings 36 and 37, or a single bearing of increased axial length, may be employed instead of the necessarily very limited length single bearings previously used.

When it is desired to remove pad 22 for any reason, this may be accomplished very easily by merely turning the pad relative to head 23, while holding head 23 manually against rotation. In the prior arrangements, the mounting of the head has been such as to preclude such a simple grasping of the head in this manner, and therefore special locking devices have been required to retain the head against rotation during removal of the pad. If it is desired to tighten or remove screw 20, this may be accomplished by merely removing pad 22, and then inserting a screwdriver through the interior of the opening formed within threads 67 of insert 68, and into engagement with the screwdriver slot of screw 40, to thereby easily turn that screw in either direction.

I claim:

1. A powered portable abrasive tool comprising a motor, a shaft driven by said motor rotatably about an axis and having a portion which is eccentric with respect to said axis and which has a second axis essentially parallel to and offset from the first mentioned axis, two similar ball bearings disposed about said eccentric portion of the shaft and having outer races, a structure mounted by said bearings for rotation about said second axis relative to said eccentric portion of the shaft, said structure including a housing disposed about said bearings, radially outwardly thereof, said structure having a forward portion at essentially a forward side of said bearings turning with said housing about said second axis relative to said eccentric portion of the shaft, a removable backing pad for carrying and driving an abrasive disc, detachable connector means at generally a central area of said forward portion of the mounting structure and operable to removably connect said pad thereto to be driven thereby, said forward portion of said structure including a forward wall disposed transversely across the front of said housing and extending radially inwardly in front of said bearings to the location of said connector means, two elastomeric cushioning sleeves about said ball bearings and radially between said outer races and said housing, one of said sleeves having an inturned end cushioning flange confined axially between one of said outer races and an inturned flange on said housing, the other sleeve having a similar inturned end flange confined axially between the other outer race and said forward wall.

2. A powered portable tool comprising a motor, a shaft driven by said motor rotatably about an axis and having a portion which is eccentric with respect to said axis, and which has a second axis essentially parallel to and offset from the first mentioned axis, ball or roller bearing means disposed about said eccentric portion of the shaft, a housing disposed about said bearing means and mounted thereby for rotation about said second axis relative to said eccentric portion of the shaft, a wall disposed essentially transversely across the forward side of said housing, fastener means connecting said wall to said housing for rotation therewith about said second axis, internal threads carried by said wall and defining a threaded recess in front of said eccentric portion of the shaft smaller in diameter than the periphery of said bearing means and extending and centered about said second axis, said wall extending generally radially inwardly in front of said bearing means to the location of said internal threads, and a removable backing pad structure for carrying and driving a work engaging disc and having an externally threaded mounting shank projecting rearwardly and removably connectible into said internal threads.

3. A powered portable tool as recited in claim 2, including a resilient cushioning element between said bearing means and said wall.

4. A powered portable tool as recited in claim 2, including a resilient cushioning element between said bearing means and said housing.

5. A powered portable tool as recited in claim 2, including a resilient cushioning sleeve disposed about said bearing means and radially between said bearing means and said housing for cushioning the mounting of said housing.

6. A powered portable tool as recited in claim 2, in which said bearing means include two similar ball bearings having outer races, there being two elastomeric cushioning sleeves about said ball bearings and radially between said outer races and said housing, one of said

sleeves having an inturned end cushioning flange confined axially between one of said outer races and an inturned flange on said housing, the other sleeve having an inturned end flange confined axially between the other outer race and said forward wall.

7. A powered portable tool as recited in claim **2**, in which said wall has an opening extending entirely therethrough at the location of said internal threads, there being a fastener for securing said bearing means on said eccentric portion of the shaft and positioned for engagement and released by a tool through said opening in said wall.

8. A powered portable tool as recited in claim **2**, in which said wall has a forward circular surface centered about said second axis for engaging said backing pad structure and which is essentially transverse but advances very slightly axially in a direction away from said bearing means as it advances radially outwardly to a peripheral edge of said surface.

9. A powered portable tool as recited in claim **2**, in which said wall has a forward circular surface centered about said second axis for engaging said backing pad structure and which is essentially transverse but advances very slightly axially in a direction away from said bearing means as it advances radially outwardly to a peripheral edge of said surface, said peripheral edge being located farther from said second axis than is the periphery of said bearing means within said housing.

10. A powered portable abrasive tool comprising a motor, a shaft driven by said motor rotatably about an axis and having a portion which is eccentric with respect to said axis and which has a second axis essentially parallel to and offset from the first mentioned axis, roller or ball bearing means disposed about said eccentric portion of the shaft, a structure mounted by said bearing means for rotation about said second axis relative to said eccentric portion of the shaft, said structure being disposed about said roller or ball bearing means and having a forward portion defining a wall disposed essentially transversely across the forward side of said bearing means, internal threads carried by said wall and disposed about said second axis, a removable backing pad structure for carrying and driving a work engaging disc and having an externally threaded mounting shank projecting rearwardly and removably connectible into said internal threads, said wall containing an opening at the location of said internal threads and forwardly opposite said eccentric portion of the shaft, and a fastener for detachably securing said bearing means on said eccentric portion of the shaft and positioned for engagement and release by a tool through said opening in said wall.

11. A powered portable tool comprising a motor, a head driven by said motor, and a removable backing pad for carrying and driving a work engaging disc and detachably connectible to said head, said pad having a threaded fastener at essentially its center threadedly connectible to said head, said head having a backing surface about said fastener engageable in backing relation with a rear surface of said pad, said two surfaces, as viewed in axial section, being shaped when undeformed to advance slightly axially away from one another as they advance radially inwardly.

12. A powered portable tool as recited in claim **11**, in which one of said surfaces is sufficiently deformable resiliently to assume the shape of the other surface upon tightening of said fastener.

13. A powered portable tool as recited in claim **11**, in which said backing surface on the head is slightly frustoconical and said rear surface on the pad is planar and transverse but resiliently deformable to conform to said backing surface.

14. A powered portable tool as recited in claim **11**, in which said backing surface on the head is slightly frustoconical and disposed at an angle of between about one-fourth of a degree and one degree to a transverse plane and has an essentially circular peripheral edge.

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