Nov. 26, 1946. R. L. MILLER ET AL 2,411,584

PORTABLE MOTOR DRIVEN TOOL

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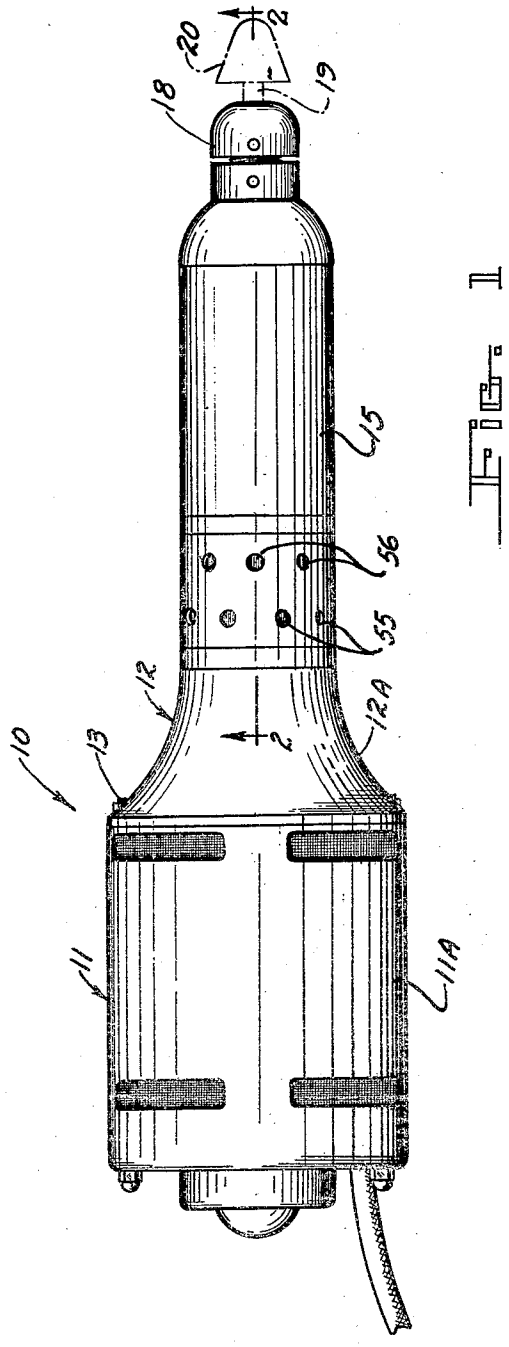


FIG. 1

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Fig. 2

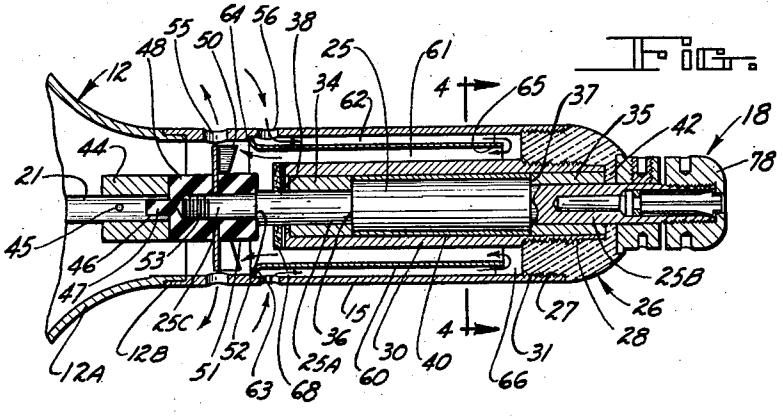


Fig. 3

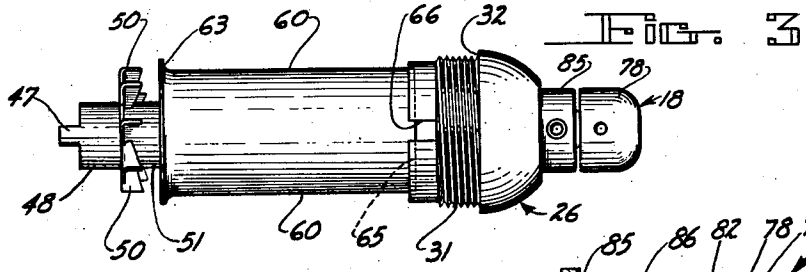


Fig. 4

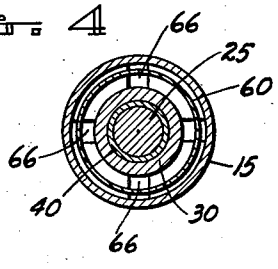
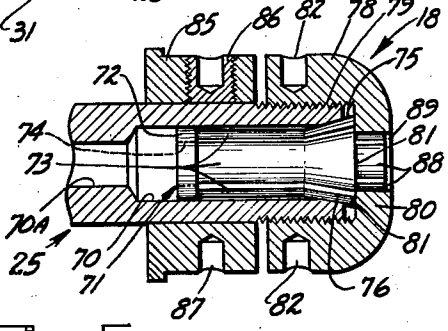


Fig. 5

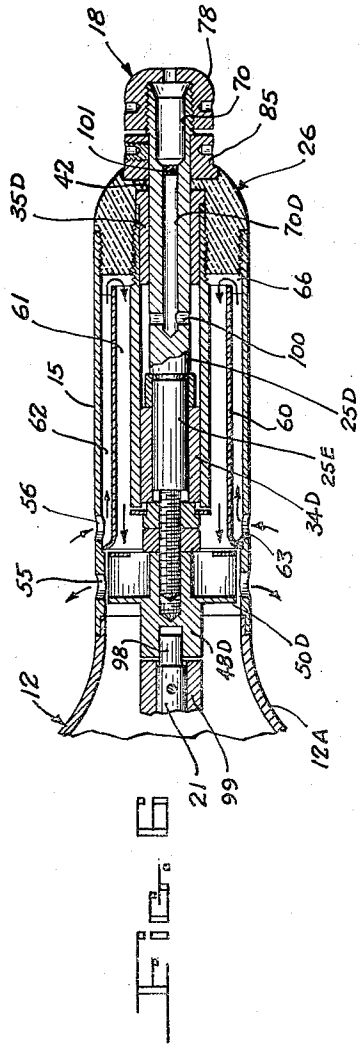


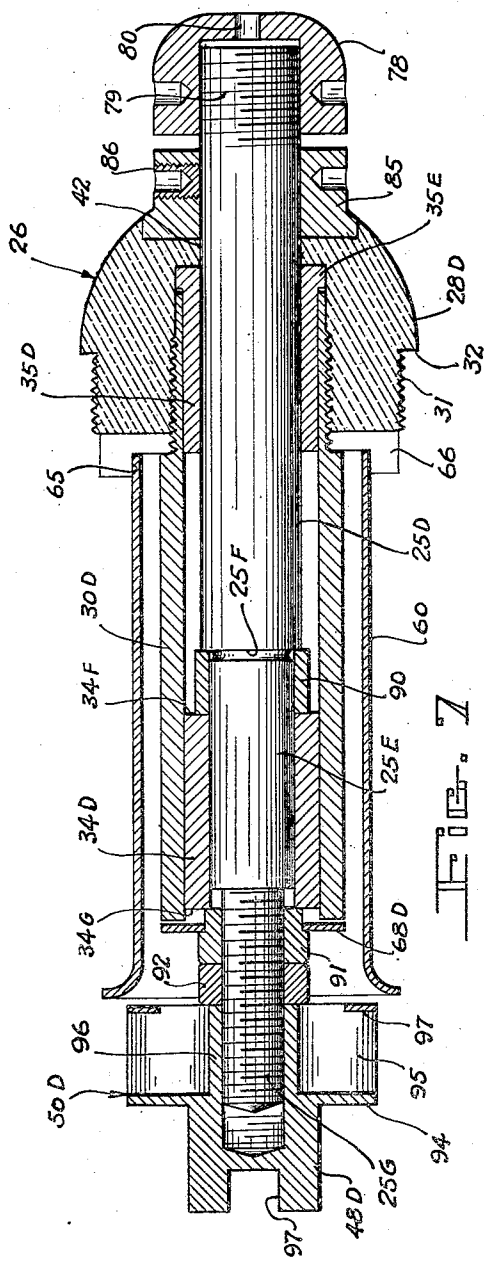
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UNITED STATES PATENT OFFICE

2,411,584

PORTABLE MOTOR-DRIVEN TOOL

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Application November 17, 1944, Serial No. 563,937

18 Claims. (Cl. 51—170)

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This invention relates to portable motor driven tools and particularly to tools of the kind that embody a small electric motor adapted to be grasped and manipulated by the user and having a tool-mounting spindle at one end thereof to receive a working tool for performing grinding, polishing, drilling, sawing, sanding, or like operations that require suitable rotating working tools.

Portable tools of the aforesaid character find their greatest usefulness in the performance of material working and forming operations that must be accurately and neatly performed, and in practice it has been found that the attainment of such accuracy and neatness in the work may be influenced by many factors of construction and form of the tool, or the condition of wear of the parts of the tool. In view of this, it is an important object of the invention to improve the construction and form of such tools and to simplify the proper lubrication as well as the repair and maintenance thereof so as to facilitate the attainment of accurate and high quality work through the use of such tools.

In the use of portable tools of the kind to which this invention relates, the tool is grasped in one or both hands, depending upon the character of the work that is to be performed, but in either event, it is desirable that the tool be grasped by one hand closely adjacent to the tool-carrying end thereof, thereby to enable steady and accurately guide movements to be imparted to the working tool as the work progresses. Thus, at least those portions of the portable tool that are adjacent to the tool-mounting end of the tool spindle must be made of such a size as to afford a handpiece that may be readily and conveniently held or grasped by the user. This must be done in such a way that the weight in the tool is distributed in a balanced relationship that facilitates handling and manipulation of the tool, and to enable this to be accomplished in an improved and simplified manner is a further object of this invention.

Portable motor operated tools of the character to which this invention relates are operated at relatively high speeds and under varying and sometimes appreciable loads, and these factors tend of course to produce heating of the parts of the tool such as the motor casing and the handpiece that surrounds the tool-carrying end of the tool spindle, and it is a further object of this invention to enable effective cooling of the parts of the portable tool to be attained in a simple and expeditious manner. Related and more specific objects of this invention are to enable cooling of the handpiece of such portable tools to be accomplished in an efficient manner, and to enable this to be done through the use of means of a simple and rugged character. Another object related to the foregoing is to cool the handpiece of such a portable tool in such a way that the spindle bearings are also cooled by the action of the same cooling means, thereby to increase the useful life of the spindle bearings, and a related and more specific object is to circulate cooling air first past the handpiece of the tool and then past the bearing structure so as to effect cooling of both the handpiece and the bearings with maximum efficiency.

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In order that accurate and high quality work may be produced with portable tools of the character to which this invention relates it is necessary that vibration and chattering of the tool be minimized, and in prior tools of this character where the motor shaft has been extended throughout the length of the tool so as to serve also as the mounting spindle, there has been a marked tendency for such shaft to whip due to improper alignment or excessive wear or looseness of the bearings. This has caused vibration and chattering in the tool and has long been recognized as an objectionable characteristic in such portable tools. It is therefore a further object to enable such vibration and chattering to be readily and easily eliminated in portable tools of the aforesaid character, and a related object is to enable an independent tool spindle to be employed in such portable tools in a separately mounted relationship with respect to the motor shaft, thereby to eliminate the objectionable effect of bearing misalignment and make it unnecessary to produce and maintain perfect bearing alignment in such portable tools. A further and related object of the invention is to support such a separate tool spindle in spaced and accurately aligned bearings that are mounted in and associated with the handpiece of such a portable tool.

The greatest wear in a portable tool of the foregoing character is known to take place in the spindle supporting bearings near the tool supporting end of the spindle, and hence as looseness appears in such bearings the tool will become increasingly subject to objectionable vibration, and it is therefore a further object of the present invention to enable the spindle of such a portable tool to be supported in the handpiece by a readily removable bearing structure. A further object of the invention is to so support and relate such a bearing structure with respect to the other elements of the tool that transmission of

heat from the spindle bearings to the handpiece is retarded and minimized. A more specific object is to enable a separately formed tool spindle in such a portable tool to be provided as a part of a spindle and bearing unit that may be readily and easily placed in or removed from an operative relationship in the handpiece of the tool. Another and related object is to so construct and arrange such a removable spindle and bearing unit that the parts thereof may readily be disassembled for repair or for replacement of imperfect or worn bearings or other parts thereof.

Other and further objects of the invention are to enable cooling means to be associated with the removable spindle and bearing assembly or unit so as to be secured in or removed from an operative position in the portable tool along with the spindle and bearing unit; to secure such unit in position in the handpiece of the portable tool by means such as a connecting head made from heat insulating material to thereby retard heat conduction from the bearings to the handpiece; to further control heat conduction by drivingly associating the motor shaft and the tool spindle by a heat insulating connection; to enable such connection to be readily effected in the assembly of the portable tool; to effect the cooling of the bearings and handpiece by cooling air driven through the spaces adjacent to such parts; to utilize flow directing wall means to control the path of such cooling air; to enable such flow directing wall means to be readily put in or removed from its operative position within said handpiece; and to utilize a fan for producing such flow and to mount such fan in a removable relationship on the tool spindle to facilitate replacement of the fan or other disassembly of the bearing and spindle unit.

In the use of portable tools of the character to which this invention relates it is customary and desirable that a large number of different kinds and sizes of working tools be available and that such tools be replaced or changed as required to most efficiently perform the work at hand. This, of course, involves frequent operation of the tool-mounting means or chuck, with the result that the chuck must be capable of withstanding hard usage and wear, and that the wearing parts of the chuck be capable of quick and easy replacement, and to enable this to be accomplished is a further object of this invention.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments and the principles thereof and what is now considered to be the best mode in which the application of those principles has been contemplated. Other embodiments of the invention embodying the same or equivalent principle may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a side elevational view of a portable tool embodying the features of the invention;

Fig. 2 is a fragmental longitudinal sectional view taken substantially along the line 2—2 in Fig. 1;

Fig. 3 is a side elevational view of the spindle, bearing and cooling unit of the tool after removal from the tool;

Fig. 4 is a transverse sectional view taken along the line 4—4 in Fig. 2;

Fig. 5 is an enlarged detail view of the chuck showing the removable spring jaw unit thereof;

Fig. 6 is a sectional view similar to Fig. 2 and illustrating an alternative embodiment of the invention; and

Fig. 7 is an enlarged sectional view of the removably mounted bearing and spindle unit of Fig. 6.

In the form chosen for disclosure in Figs. 1 to 5 the invention is embodied in a portable motor driven tool 10 having an enclosed electric motor 11 at one end of which a separately formed and generally cylindrical casing 12 is secured by means such as bolts 13 so as to extend longitudinally from that end of the motor 11 in substantially coaxial relationship thereto. The casing 12 includes a separately formed tapered portion 12A, the large end of which is substantially the same diameter as the casing 11A of the motor 11. The casing portion 12A tapers inwardly in an inwardly concave relationship so as to merge with a cylindrical portion 15 of the casing 12 with which it is connected by means such as a welded lap joint 12B. The cylindrical portion 15 is of such a size as to constitute a handpiece that may be readily grasped between the thumb and forefinger of a user, and when the tool 10 is thus held by a user the tapered portion 12A of the casing 12 rests upon the web of the hand between the thumb and forefinger so that the tool may be readily moved and manipulated as required by the character of the work being performed.

As will hereinafter be described in detail, the handpiece 15 serves to house a spindle structure that is driven by the motor 11 and which terminates in a chuck 18 in which the mandrel 19 of a working tool such as a grinder 20 may be secured, and it is by means of a working tool such as the grinder 20 that the desired work is performed with the tool 10. As shown in Fig. 2 of the drawings, the motor 11 has a shaft 21 that extends into the flared portion 12A of the casing 12 substantially to the juncture of the portions 12A and 15 of the casing 12, and a separately formed spindle 25, which carries the chuck 18 at one end thereof, is supported within the handpiece 15 so that its other end is connected to and driven by the motor shaft 21.

In accordance with the present invention the spindle 25 and the bearing means that support the same within the handpiece 15 are arranged for removal as a unit from the operative position thereof, and in accordance with certain aspects of the invention, cooling means for the bearing means and the handpiece 15 are arranged for removal concurrently with the removal of the spindle and bearing unit. The removable unit that is thus afforded is shown in Fig. 3 of the drawings wherein it will be evident that the removable unit includes a mounting head 26 that serves to support the unit in position within the handpiece 15. Thus the mounting head 26 has an axial sleeve portion 27 that is internally threaded at 28 to embrace complementary external threads formed on one end of a supporting sleeve 30 in which the spindle 25 is rotatably supported. The sleeve portion 27 of the mounting head 26 also has external threads 31 thereon terminating in a shoulder 32, Fig. 3, so that the head may be threaded into complemental internal threads formed in the outer end of the handpiece. The shoulder 32 serves of course to abut the end edge of the handpiece 15, thereby to accurately locate the supporting sleeve 30 within the handpiece 15.

The mounting head 26 also serves to removably secure the spindle 25 in position in the supporting sleeve 30, and in accordance with the embodiment of the present invention that is shown in Figs. 1 to 5, the mounting of the spindle 25 in the sleeve 30 is such as to afford readily removable sleeve bearings 34 and 35 which may be easily and conveniently replaced when this is required. Thus, as will be evident in Fig. 2 of the drawings, the spindle 25 has reduced portions 25A and 25B adjacent to opposite ends thereof, thereby affording oppositely facing annular shoulders 36 and 37. The sleeve bearing 34 is arranged to surround and support the reduced portion 25A of the spindle 25 and is located within the supporting sleeve 30 so that one end of the bearing 34 is opposed to the shoulder 36 and the other end thereof bears against an inwardly projecting annular flange 38 formed on the innermost end of the supporting sleeve 30. A spacer sleeve 40 is disposed about the large portion of the spindle 25 so as to be spaced from the spindle, and the other sleeve bearing 35 is disposed about the reduced portion 25B of the spindle 25 so that one end edge of the bearing 35 engages the adjacent end of the spacer sleeve 40. Thus, when the mounting head 26 is screwed onto the threaded end of the supporting sleeve 30 an inwardly projecting flange 42 thereof engages the other end edge of the sleeve bearing 35, thereby to clamp the bearing 35, the spacer sleeve 40 and the bearing 34 firmly in predetermined endwise positions within the supporting sleeve 30 and the flanges 38 and 42 respectively. The length of the spacer sleeve 40 is of course proportioned and related to the distance between the shoulders 36 and 37 so that these shoulders have an efficient thrust bearing relationship with the adjacent end surfaces of the sleeve bearings 34 and 35, and hence the spindle 25 is supported both rotatively and in an endwise direction by the sleeve bearings 34 and 35.

In accordance with the present invention, the inner end of the spindle 25 is drivingly connected with the motor shaft 21 by means that may be readily engaged or disengaged as an incident to endwise movement of the spindle in the mounting or removal thereof. Thus, as shown in Figs. 2 and 3, complemental engaging means are provided on the adjacent ends of the spindle 25 and the motor shaft 21, the means on shaft 21 comprising a collar 44 secured thereon by a pin 45, and this collar 44 has a transverse slot 46 in the end thereof adapted to receive a transverse tongue 47 formed on a member 48 secured on the adjacent end of the spindle 25. Hence the tongue 47 may be inserted in or removed from the slot 46 by endwise movement of the spindle. As herein shown the member 48 is formed from heat insulating material such as hard rubber, and it serves also as a part of the means for securing a fan 50 in position on the spindle 25, and to enable this to be accomplished, a hub 51 of insulating material is disposed on a reduced end portion 25C so as to abut a shoulder 52 formed between the sections 25A and 25C of the spindle 25, and the fan 50 is placed in position about the portion 25C just to the left of the hub 51. The fan 50 may thus be clamped removably in position by the member 48 which for this purpose is arranged to have a screw threaded connection 53 on the end of the portion 25C of the spindle, as shown in Fig. 2, such threaded connection being such as to transmit drive in the desired direction.

When the spindle and bearing unit is in position within the handpiece 15 the fan 50 is disposed substantially opposite an annular row of air discharge openings 55, Figs. 1 and 2, so that when the tool is operated, the fan 50 may function to draw cooling air into the handpiece 15 through intake openings 56 so as to reduce the temperature of the handpiece and the bearing means. In attaining this cooling action the present invention provides means for directing and controlling the circulating path of the cooling air, such means being effective to pass the air forwardly from the intake openings 56 along the inner surface of the handpiece 15 and then back along the outer surface of the bearing supporting sleeve 30 so as to discharge the air from the annular row of outlet openings 55 that in the present instance are formed in the handpiece 15 somewhat rearwardly of the openings 56, as shown in Figs. 1 and 2. The air directing means for producing such flow of the cooling air is preferably afforded by a sleeve 60 that is of such a diameter, as shown in Fig. 2, that it may be located between the sleeve 30 and the handpiece 15 so as to form inner and outer annular passages 61 and 62, and to separate these passages at the left hand or inner ends thereof, the sleeve 60 is flared or flanged outwardly as at 63 so as to engage the inner surface of the handpiece 15, between the two rows of openings 55 and 56. In the present case the flange 63 is arranged to engage the annular shoulder 64 formed on the inner surface of the handpiece for by this arrangement it is possible to simplify the mounting of the sleeve 60 as will hereinafter appear.

At its forward or right hand end as viewed in Figs. 2 and 3, the air directing sleeve 60 is supported by the mounting head 26, and the arrangement and relationship are such as to provide communication between the inner and outer passages 61 and 62. In the present instance the forward end of the sleeve 60 is arranged to fit snugly within a counterbore 65 formed in the end of the flange 27 of the head 26, and transverse slots 66 are formed in the flange 27 to a depth substantially greater than the depth of the counterbore 65, thereby to afford a plurality of radial passages between the forward ends of the passages 61 and 62. Thus, the cooling air drawn into the inlet openings 56 is first circulated through the passage 62 along the inner surface of the handpiece 15 so as to cool the handpiece, and this air then moves radially inwardly through the passages 66 and rearwardly through the passage 61 and along the outer surface of the sleeve 30 so as to cool the bearing means of the tool. As a further precaution against heating of the handpiece 15, the bearings of the spindle 25 are in effect segregated from the handpiece 15 by forming the mounting head 26 from a heat insulating material such as Formica, as indicated in Fig. 2, which has ample rigidity to hold the spindle and bearing unit in position while serving to check objectionable heat transmission to the handpiece 15.

From the foregoing it will be evident that the spindle and bearing unit, together with the elements of the cooling system may be readily removed for replacement or repair, and the various parts of this removable structure being so formed and related to each other that disassembly may be readily effected for purposes of inspection or replacement of worn or damaged parts. In this connection it will be observed that a washer 68 of fiber or like material is mounted on the portion 25A of the spindle adjacent to

the inner end of the bearing supporting sleeve 30, and this washer rotates with the spindle 25 so as to act as a slinger for throwing abrasive and the like outwardly from the spindle 25, thereby to prevent such abrasive from reaching the bearings 34 and 35.

In accordance with the present invention the chuck 18 is so constructed and arranged that different sizes of tool mandrels 19 may readily be supported in the chuck and to enable this to be accomplished and to simplify the construction of the chuck, the forward end section 25B of the spindle 25 has an axial bore 70 formed therein to receive a chuck jaw member 71. The chuck jaw member 71 comprises a ring 72 having a plurality of spring fingers 73 extending forwardly therefrom to afford chuck jaws adapted to be bent or forced radially toward each other to engage and grip the surface of a mandrel 19 of a working tool 20. It will be noted in this connection that the ring 72 has a central opening 74 therein so that such a mandrel 19 may extend through the opening 74 and into a reduced portion 70A of the bore 70. This enables the tool 20 to be located quite close to the chuck 18, thereby to facilitate accurate control of the tool when in use.

It will be observed that the spring fingers 73 have rearwardly sloping outer surfaces 75 near the end portions thereof for camming engagement with a sloping annular surface 76 on the inner face of the bore 70 at the forward end of such bore. Thus when the jaw member 71 is forced rearwardly into the bore 70, the surfaces 75 and 76 cooperate with a cam action to bend the jaws or fingers 73 radially inwardly and into clamping engagement with the mandrel 19 of the working tool. Such endwise displacement of the jaw member 71 is effected by a nut 78 threaded onto the outer end of the spindle 25 at 79 and having an inwardly extending flange 80 that engages forwardly facing shoulders 81 formed on the respective fingers 73. The nut 78 may be tightened or otherwise rotated by a suitable wrench formed for engagement with radial sockets 82 formed in the sides of the nut, and to hold the spindle 25 against rotation during such an operation a collar 85 is secured thereon by a socketed set screw 86, and the collar 85 is provided with radial sockets 87 that may be engaged by a wrench when this is required. When the nut 78 is loosened the cam action of the two surfaces 75 and 76 causes the chuck jaw member 71 to move forwardly, thus to release the jaws 73. In the present instance the jaws 73 have finger portions 88 formed thereon forwardly of and beyond the shoulders 81 so as to extend into the central opening 89 in the flange 80 of the nut 78.

In Figs. 6 and 7 of the drawings, an alternative embodiment of the invention is illustrated whereby manufacture is facilitated and additional life in the bearings of the tool may be obtained. In this embodiment of the invention, the spindle and bearing unit is illustrated as being supported in a handpiece 15 that is of the same form and construction as that shown in Figs. 1 and 2 so that the spindle and bearing unit is operatively associated with the end of the motor shaft 21 so as to be driven in the same manner as hereinbefore described in connection with the other embodiment of the invention. In this alternative embodiment of the invention the elements of the chuck 18, the mounting head 26 and the air directing sleeve 60 are illustrated as being of the same construction as that hereinbefore described,

and similar reference characters have therefore been employed in respect to these corresponding elements of the mechanism.

It will be observed however that the spindle is somewhat different in form and for this reason, the spindle has been identified by the reference character 25D. Thus, as will be evident in Fig. 7 of the drawings, the spindle 25D has external screw threads 79 formed thereon to receive the complemental internal threads of the head 78, and it will be observed that the spindle 25D is of a uniform diameter throughout a substantial portion of its length, but that near its left-hand or inner end, the spindle is reduced as at 25E so as to form a bearing portion that terminates in a rearwardly facing annular shoulder 25F. To the left of the portion 25E, the spindle has a further reduced and threaded portion 25G that is utilized as will hereinafter be described for the purpose of securing the spindle in position within the bearing means carried in a mounting sleeve 30D.

The mounting sleeve 30D is generally the same as the sleeve 30 shown in Fig. 2, but it will be observed that the flange 33 has been eliminated, thereby to afford a uniform internal diameter throughout the length of the sleeve 30D. The outer or right-hand end of the spindle 25D is rotatably supported in the bearing sleeve 30D by a bearing 35D that has a flange 35E at its outer or right-hand end so as to engage the end of the supporting sleeve 30D, as is best shown in Fig. 7 of the drawings, and the bearing sleeve 35D is held in position within the mounting sleeve 30D by the flange 42 of the head 26 when the threads 28D of the head 26 are threaded onto the complemental external threads of the mounting sleeve 30D.

Bearing means are afforded for the inner or left-hand end portion of the spindle 25D by a bearing sleeve 34D that is mounted within the sleeve 30D by a press fit so as to surround the reduced portion 25E of the spindle. In order that a simple and efficient thrust bearing means may be afforded for the spindle 25D, a thrust bearing member in the form of a sleeve 90 is mounted in surrounding relation to the reduced portion 25E of the spindle so as to be disposed between the end surface 34F of the bearing 34D and the shoulder 25F on the spindle 25D. Through this arrangement, the formation of the end surface of the bearing 34D and the formation of the shoulder 25F is simplified, and the necessary rotative motion between the spindle 25D and its thrust bearing means may take place either at the surface 34F or at the shoulder 25F.

In this alternative embodiment of the invention, the desired normal thrust relationship between the shoulder 25F and the thrust bearing means is attained by a nut 91 that is threaded on the reduced end 25G so as to abut the left-hand end 34G of the bearing 34D, and the desired adjusted relationship is maintained through the cooperation of a lock nut 92 that may be tightened against the nut 91. The nut 91 also serves as a mounting for a washer 68D so as to locate this washer relatively close to the adjacent end surface of the supporting sleeve 30D. Thus the washer 68D acts as a slinger which will prevent entry of abrasive or the like into the bearings of the assembly.

After the lock nut 92 has been placed in position on the spindle 25D, a fan 50D is mounted on the spindle, but it will be recognized that

before this is done, the air directing sleeve **60** is placed in position with its outer or right-hand end disposed within the counterbore **65** of the head **26**. The fan **50D**, as herein shown, is made as a casting that includes a mounting hub **48D** and a plate-like wall **94** having fan blades **95** extended from the plate **94**. The blades **95** terminate at their inner ends in an internal sleeve **96** that constitutes a continuation of the hub **48D**, and the sleeve **96** is internally screw threaded so that it may be threaded onto the reduced portion **25G** of the spindle and into engagement with the lock nut **92**. In the present instance, a washer or ring **97** is associated with the right-hand edges of the blades **95** near the outer ends thereof, thereby to strengthen the blades **95** and afford a well-defined inlet opening for the fan **50D**. The hub **48D** has a transverse groove **97** formed therein so that this groove may embrace a tongue **98** formed on a connecting member **99** that is pinned to the shaft **21** so as to serve as a function that corresponds with the function served by the connector **44** of Fig. 2.

The bearings **34D** and **35D** may, under the present invention, be readily lubricated without disassembly of the tool, and to enable this to be accomplished the central bore **70D** is extended from the socket **70** to a point intermediate the bearings where it intersects with a cross bore **100**. Thus a lubricant may be introduced into the socket **70** to pass through the bore **70D** and the cross bore **100** into the space about the spindle and between the bearings. Such lubricant will then pass to the bearing surfaces, and to prevent entry of dirt or abrasive with such lubricant, a felt pad **101** may be disposed in the bore **70D**. It will be recognized of course that such a lubricating structure may be used with the structure of Figs. 1 to 5 as well as with the structure shown in Figs. 6 and 7.

From the foregoing description it will be evident that the present invention materially simplifies the manufacture, maintenance and repair of portable tools of the kind to which the invention relates, and in addition, the provision of a separately assembled spindle and bearing unit that is capable of convenient removal, repair or replacement enables vibration of the tool to be reduced or eliminated in a simple and expeditious manner. The present invention also provides for efficient cooling of the handpiece and the bearings, and this cooling action is attained in such a way that the cooling air first passes the surfaces of the handpiece and then passes the surfaces of the bearing sleeve. Thus the most efficient cooling action is attained in respect to both the bearings and the handpiece, and maximum wear of the bearings is assured, as well as convenience in handling and manipulation of the tool. Such cooling action is attained in the tool of the present invention by means of a simple character, and such means are so related to the removable spindle and bearing unit that the cooling means may be readily removed with such unit and may be conveniently disassembled to facilitate repair or inspection not only of the elements of the cooling system but also of the bearing means.

Thus, while selected embodiments of the invention have been illustrated and described herein, it is to be understood that these are capable of variation and modification, and therefore, the invention is not to be limited to the precise details set forth, but is to be considered as including all such changes and alterations as fall within the purview of the following claims.

We claim:

1. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a unitary spindle and bearing unit comprising a tool spindle, a bearing member in which said spindle is rotatably supported, means on said unit for securing said unit in position within said handpiece, and cooperating means on the adjacent ends of said shaft and said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece.

2. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a unitary spindle and bearing unit comprising a tool spindle, a supporting member, individual bearing members rotatably supporting said spindle in said supporting member, a mounting head releasably securing said bearing members and said spindle in position in said supporting member and releasably securing said supporting member in position within said handpiece, and cooperating means on the adjacent ends of said shaft and said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece.

3. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user and secured rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a unitary spindle and bearing unit comprising a tool spindle, a bearing member in which said spindle is rotatably supported, means on said unit securing said unit in an operative position within said handpiece, and cooperating means on adjacent ends of said shaft and said spindle and affording a drive transmitting connection therebetween when said unit is in said operative position.

4. In a portable tool, a drive motor having a shaft driven thereby, a generally cylindrical casing of a size adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a tool spindle having means at one end thereof for mounting a working tool thereon, an elongated supporting sleeve disposed within said handpiece and through which said spindle is extended, bearing means in said supporting sleeve for rotatably supporting said spindle, means acting between said supporting sleeve and said bearing means to removably maintain said bearing means in position in said supporting sleeve, releasable connecting means acting between said handpiece and

said supporting sleeve to support said supporting sleeve in position within said handpiece, and cooperating means on said shaft and the other end of said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece.

5. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user and secured rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a tool spindle having means at one end thereof for mounting a working tool thereon, an elongated supporting sleeve disposed within said handpiece and through which said spindle is extended, bearing means in said supporting sleeve for rotatably supporting said spindle, a mounting head having means acting between said supporting sleeve and said bearing means to removably maintain said bearing means in position in said supporting sleeve, means on said mounting head acting between said handpiece and said supporting sleeve to removably support said supporting sleeve in position within said handpiece, and cooperating means on said shaft and the other end of said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece.

6. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user and secured rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a tool spindle projecting at one end beyond the end of said handpiece and having means at said one end thereof for mounting a working tool thereon, an elongated supporting sleeve disposed within said handpiece and through which said spindle is extended, bearing means secured in said supporting sleeve for rotatably supporting said spindle, releasable connecting means acting between said end of said handpiece and said supporting sleeve to support said supporting sleeve in position within said handpiece with said spindle in an operating position, and cooperating means on said shaft and the other end of said spindle, for driving said spindle when the spindle is in said operating position.

7. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user and secured rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a tool spindle having means at one end thereof for mounting a working tool thereon, an elongated supporting sleeve disposed within said handpiece in radially spaced relation thereto, said spindle being extended through said supporting sleeve, bearing means in said supporting sleeve for rotatably supporting said spindle, means acting between said supporting sleeve and said bearing means to removably maintain said bearing means in position in said supporting sleeve, releasable connecting means acting between said handpiece and said supporting sleeve to support said supporting sleeve in position within said handpiece, said handpiece having a plurality of openings therein arranged in two annular rows located adjacent to said motor and spaced axially of said handpiece, an air directing sleeve disposed in the space between said supporting sleeve and the interior of said handpiece and cooperating therewith to afford a passage leading from one row of said openings along said supporting sleeve and then back along the interior of said handpiece to the other row of openings, a fan mounted on said spindle adjacent to one of said rows of openings for forcing air through said passage, and cooperating means on said shaft and the other end of said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece.

8. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a tool spindle having means at one end thereof for mounting a working tool thereon, an elongated supporting sleeve disposed within said handpiece in radially spaced relation thereto, said spindle being extended through said supporting sleeve, bearing means in said supporting sleeve for rotatably supporting said spindle, a mounting head having means acting between said supporting sleeve and said bearing means to removably maintain said bearing means in position in said supporting sleeve, means on said mounting head acting between said handpiece and said supporting sleeve to support said supporting sleeve in position within said handpiece, said handpiece having a plurality of openings therein arranged in two annular rows located adjacent to said motor and spaced axially of said handpiece, an air directing sleeve disposed in the space between said supporting sleeve and the interior of said handpiece and having a flanged end disposed so as to engage the inner surface of said handpiece between said rows of openings, said air directing sleeve cooperating with said handpiece to afford a passage leading from one row of said openings along said supporting sleeve to said head and another passage between said directing sleeve and the interior of said handpiece from said head to the other row of openings, said head having a counterbore into which the other end of said air directing sleeve is directed and said head having transverse openings therein forming a connection between said passages, a fan mounted on said spindle adjacent to one of said rows of openings for forcing air through said passages, and cooperating means on said shaft and the other end of said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece.

9. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, said handpiece having a plurality of openings therein arranged in two annular rows located adjacent to said motor and spaced axially of said handpiece, a removable tool spindle and cooling unit mounted in an operative position in said handpiece and comprising

a tool spindle having means at one end thereof for mounting a working tool thereon, an elongated supporting sleeve disposed within said handpiece in radially spaced relation thereto, said spindle being extended through said supporting sleeve, bearing means in said supporting sleeve for rotatably supporting said spindle, means acting between said supporting sleeve and said bearing means to removably maintain said bearing means in position in said supporting sleeve, releasable connecting means acting between said handpiece and said supporting sleeve to support said supporting sleeve in position within said handpiece, an air directing sleeve disposed in the space between said supporting sleeve and the interior of said handpiece and cooperating therewith to afford a passage leading from one row of said openings along said supporting sleeve and then back along the interior of said handpiece to the other row of openings, a fan mounted on said spindle adjacent to one of said rows of openings, and means on the said other end of said spindle adapted to be drivingly engaged by said shaft when said unit is in said operative position.

10. In a portable tool, a driver motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a unitary spindle and bearing unit comprising a tool spindle, said spindle being formed with reduced portions at opposite ends to afford oppositely facing annular shoulders, sleeve bearings surrounding said reduced portions of said spindle adjacent to said shoulders, a supporting sleeve surrounding said sleeve bearings and the portion of said spindle therebetween, an internal flange at one end of said supporting sleeve and against which one end of one of said sleeve bearings is engaged, a mounting head removably secured on the other end of said supporting sleeve and having an inwardly extended flange engaging the opposite end of the other sleeve bearing to hold the same in position in said supporting sleeve, means on said mounting head engaging said handpiece to removably secure said supporting sleeve in said handpiece with said spindle substantially coaxial with said shaft, and cooperating means on the adjacent ends of said shaft and said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece.

11. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a unitary spindle and bearing unit comprising a tool spindle, said spindle being formed with reduced portions at opposite ends to afford oppositely facing annular shoulders, sleeve bearings surrounding said reduced portions of said spindle adjacent to said shoulders, a supporting sleeve surrounding said sleeve bearings and the portion of said spindle therebetween, an internal flange at one end of said supporting sleeve and against which one end of one of said sleeve bearings is engaged, a mounting head removably secured on the other end of said supporting sleeve and having an inwardly extended flange engaging the opposite end of the other sleeve bearing to hold the same in position in said supporting sleeve, a spacer sleeve surrounding said spindle in spaced relation thereto and between said sleeve bearings and arranged to abut the adjacent ends of said sleeve bearings to space the same and insure proper clamping and positioning thereof between said flanges, means on said mounting head engaging said handpiece to removably secure said supporting sleeve in said handpiece with said spindle substantially coaxial with said shaft, and cooperating means on the adjacent ends of said shaft and said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece.

12. In a unitary tool spindle and bearing unit for use in a portable tool, a tool spindle having reduced end portions at opposite ends affording oppositely facing shoulders, sleeve bearings on said reduced opposite ends of said spindle adjacent to said shoulders, a supporting sleeve surrounding said sleeve bearings and the intermediate portion of said spindle, a spacer sleeve within said supporting sleeve and surrounding said intermediate portion of said spindle in spaced relation to the spindle, means on one end of said supporting sleeve against which an end of one of the sleeve bearings abuts, a mounting head screw-threaded onto the other end of said supporting sleeve and having a flange engaging the opposite end of the other sleeve bearing to removably secure said sleeve bearings and said spindle in position in said supporting sleeve, said head having external screw threads formed thereon for mounting the unit in a portable tool, chuck means on the end of said spindle adjacent to said mounting head, and means on the other end of said spindle adapted to engage driving means in such a portable tool.

13. A unitary tool spindle and bearing unit for use in a portable tool, said unit comprising a tool spindle having chuck means at one end thereof, a bearing member in which said spindle is rotatably supported, means on said unit adjacent to said one end of said spindle for securing said unit in position on such a portable tool, the other end of said spindle adapted to be drivingly engaged by the motor shaft of such a portable tool.

14. In a unitary tool spindle and bearing unit for use in a portable tool, a tool spindle having reduced end portions at opposite ends affording oppositely facing shoulders, sleeve bearings on said reduced opposite ends of said spindle adjacent to said shoulders, a supporting sleeve surrounding said sleeve bearings and the intermediate portion of said spindle, a spacer sleeve within said supporting sleeve and surrounding said intermediate portion of said spindle in spaced relation to the spindle, means on one end of said supporting sleeve against which an end of one of the sleeve bearings abuts, a mounting head screw threaded onto the other end of said supporting sleeve and having a flange engaging the opposite end of the other sleeve bearing to removably secure said sleeve bearings and said spindle in position in said supporting sleeve, said head having external screw threads formed thereon for mounting the unit in a portable tool, chuck means on the end of said spindle adjacent to said mounting head, a fan disposed on and adjacent to the other end of said spindle, a nut threaded onto said other end of said spindle to hold said fan removably in place thereon, and means on

said nut adapted to engage driving means in such a portable tool.

15. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a unitary spindle and bearing unit comprising a tool spindle formed with a reduced portion at one end to afford an annular shoulder facing toward said end, a supporting sleeve surrounding a portion of said spindle, bearing means in said sleeve including sleeve bearing means fixed longitudinally in said sleeve adjacent one end thereof and surrounding said reduced portion of said spindle, a thrust member removably secured on said reduced end of said spindle and engaging one end of said sleeve bearing means to hold the same against said shoulder to thereby hold said spindle in position in said supporting sleeve, a mounting head secured on the other end of said sleeve and having means thereon engaging said handpiece to removably secure said supporting sleeve in said handpiece with said spindle substantially coaxial with said shaft, and cooperating means on the adjacent ends of said shaft and said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece.

16. In a portable tool, a drive motor having a shaft driven thereby, a generally cylindrical casing of a size adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a tool spindle having chuck means at one end thereof for mounting a working tool thereon, an elongated supporting sleeve disposed within said handpiece and through which said spindle is extended, bearing means in said supporting sleeve for rotatably supporting said spindle, releasable connecting means acting between said handpiece and said supporting sleeve to support said supporting sleeve in position within said handpiece, cooperating means on said shaft and the other end of said spindle and affording a drive transmitting connection therebetween adapted to be disengaged by endwise withdrawal of said spindle from said handpiece, and lubricating means for said bearing means comprising a bore extended into said spindle from said one end thereof and opening through the side surface of said spindle adjacent to said bearing means, and filter means disposed in said bore and operable to prevent passage of abrasive and the like through said bore.

17. In a portable tool, a drive motor having a shaft, a generally cylindrical casing of a size adapted to be grasped by one hand of a user and secured rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a tool spindle projecting at one end beyond the end of said handpiece and having chuck means at said one end thereof for mounting a working tool thereon, an elongated supporting sleeve disposed within said handpiece and through which said spindle is extended, bearing means secured in said supporting sleeve for rotatably supporting said spindle, said spindle having a lubricating passage extended therethrough from said one end through which lubricant may be fed to said bearing means, releasable connecting means acting between said end of said handpiece and said supporting sleeve to support said supporting sleeve in position within said handpiece with said spindle in an operating position, and cooperating means on said shaft and the other end of said spindle, for driving said spindle when the spindle is in said operating position.

18. In a portable tool, a drive motor having a shaft, a generally cylindrical casing adapted to be grasped by one hand of a user, means securing one end of said casing rigidly to said motor so as to project therefrom substantially coaxially with respect to said shaft to thereby afford a handpiece whereby the tool may be grasped and manipulated, a unitary spindle and bearing unit comprising a tool spindle, a supporting member having bearings rotatably supporting said spindle and having a screw threaded portion at its outer end, a mounting head screw-threaded onto said end of said supporting member, said head having external screw threads formed thereon for mounting said unit in an operative position within and in spaced relation to the walls of said casing, said head also being formed from a heat insulating material to segregate the heat producing bearings from the handpiece, and means on the other end of said spindle adapted to be drivingly engaged by said shaft when said unit is in operative position.

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