The invention relates to a portable power-driven tool of the rotary type.

While a drill has been chosen as the particular embodiment of the invention to be described, the invention is adapted to more general application, being capable of use in portable power-driven rotary tools for various purposes, as taping, sanding, grinding, and polishing; and while certain features of the invention relate particularly to electric tools, other features are capable of more general application.

The object of the invention is to produce a tool of this type which, though capable of general use, is more particularly adapted for use in confined or restricted spaces where a tool of the usual dimension in the direction of the axis of the bit cannot be introduced, the tool of the invention having greatly increased facility for use in this way as compared to existing types.

The improved tool to which the invention is applied has the axis of the spindle, the chuck, and the bit transversely related to the motor axis and, in accordance with the invention, the tool is so arranged and proportioned that it can be held in and directed by one hand, which is an important advantage, as there are many instances in which it is difficult or impossible for the operator to reach with both hands the locality where the work is to be done, and it also frequently occurs that one hand of the operator may be otherwise engaged, as in holding other tools, positioning the work, or maintaining the working position.

The tool of the invention has the further important advantage that it is so arranged that the fingers of the hand of the operator, which is guiding and directing the tool, may engage the tool casing immediately adjacent the shank of the bit, thus effecting a most satisfactory guidance of the tool when supported in one hand, the tool case—or, more particularly, the gear casing at the head—being so arranged that the fingers of the operator in this position are protected from contact with the rotating chuck.

In order to arrange to the best advantage for the one-hand operation described, the gear casing is provided with a nose surrounding the chuck and is further so formed and arranged that the hand may grip the gear casing with the palm of the hand engaging the casing directly back of and in line with the bit and the axis of the chuck, the gear casing being arranged and of such configuration and so proportioned as to its length that the fingers grip the nose and are free from contact with the rotary chuck.

While the relation of the palm grip to the nose whereby the fingers engage the nose near the drill shank is of great importance and advantage, the palm grip is of advantage independently of the chambered nose.

It is a further important accomplishment of the invention that air is supplied without interruption to the motor for cooling and also to the gear casing for cooling the latter, the ventilation being so arranged that it is not impeded or interfered with by the hand of the operator in the position described, it being an important advantage in this type of tool that the air draft passes either through or along the outer surface of the gear case, thus helping to cool the gear case and avoiding over-heating of the gear case which would be highly detrimental to the one-hand operation described.

While the drill or other rotary tool of the invention is particularly adapted to be directed and supported by one hand of the operator in the manner already suggested, it can also be supported and directed by the operator using one or both hands to grasp the motor case or field case, the axis of which is transverse to the bit and tool spindle. By thus handling the tool it can, for some purposes, be introduced into even smaller spaces than when supported and directed in and by one hand grasping the gear case. Where the tool is directed by grasping the motor housing or barrel, two hands are generally necessary to exert sufficient pressure in the direction of the bit axis to secure proper operation of the tool.

It is also of advantage that the gear case and motor case are preferably threaded together, the casing being combined without the use of screws, bolts, and the like. It is of further advantage, contributing to the adaptability of the tool for use in places generally considered inaccessible for work with power tools, that the tool is of a dimension in the direction of the axis of the drill bit which is approximately half the length of the previous tools, being approximately three inches whereas the shortest full-powered drill on the market is about seven inches long. The drill of the invention is fully powered, being preferably driven by a small high-speed motor.

In the drawings:
Figure 1 is a full size side elevation of the tool in the form which is now regarded as the preferred form of the invention.
Figure 2 is an elevation looking at the tool from the left in Figure 1.
Figure 3 is a fragmentary view on an enlarged...
scale, the same being broken away to show the internal construction of the tool on a plane of the axis of the motor.

Figure 4 is a section in the plane of the motor and spindle axis.

Figure 5 is a section in the line 5—5 in Figure 4.

Figure 6 is an elevation corresponding to Figure 1 and showing a second form of tool.

Figure 7 is a section on line 7—7 in Figure 6.

Figure 8 is an elevation illustrating a third form of the tool.

Figure 9 is a sectional elevation looking to the left in Figure 8.

Figure 10 is an elevation of the tool of the type shown in Figure 1, showing the manner of grasping the same by the hand in the single-handed control of the tool, half size.

Figure 11 illustrates the operation of the tool in a confined place, as between the struts of an airplane wing, the drilling and assembling of which is an operation to which the tool is particularly adapted.

Referring to the drawings by numerals, each of which is used to indicate the same or similar parts in the different figures, the construction shown having particular reference to Figures 1, 2, 3, 4 and 5, comprises an electric motor 1 enclosed in a field case or motor housing 2. This field case or motor housing 2 is closed at one end by a brush and switch housing 3 and at the other end by a gear casing 4. These are rigidly secured in any suitable manner, preferably as heretofore described. The field case 2, of which the brush housing is an extension, is referred to as the barrel.

In the preferred form of the invention shown, the motor shaft 5, which is preferably in the line of the axis of the casing, has secured thereto and mounted thereon at one end of the motor a ventilating or cooling fan 6. In the form shown the fan draws air through and around the motor in accordance with the usual practice in motor ventilation, the air being introduced through ventilating holes 7 in the field casing 3, passed to the left around the motor and between the armature and field and ejected through and by way of the draft passages 8, 9 in the gear casing and the ring 12. It is of interest in the construction of the casing that the field or motor casing 3 be drawn or connected at 11 with a ring 12 which has a central bearing boss 10 which is threaded into the gear casing 4 at 14, the nose 15 which encloses the chuck 16 in a manner to be described being threaded into the gear casing 4 at 17.

The gear casing 4 is provided with bearings 18 and 19 in which a tool spindle 20 is supported at right angles to the motor axis, being driven by pinion 21 on the motor shaft 5, which pinion meshes with the toothed gear 22 mounted on and secured to the spindle. The motor shaft is supported in bearings 24 in the ring 12 immediately adjacent the pinion 21 and between the field 6 and said pinion. It is also of interest that the bearing portion of the ring is connected to the ring proper by radial ribs 12' between which are passages or openings 8' which connect the fan chamber 31 to the annular passage 8, all details being subject to variation.

It is an important feature of the invention that the gear casing 4 supporting the spindle 20 at right angles to the motor shaft is constructed of a size and shape to fit within the palm of the hand. In the most highly developed form it is so proportioned and arranged that the fingers extend down over the sides of the gear casing 4, with their ends bearing on the nose 16 of the casing, as best illustrated in Figure 10. This arrangement is best adapted to the direction of the tool when held in one hand.

As seen from the left in Figure 1, and as seen in Figure 2 the gear casing 4 and nose 16 together form a pear shaped body, the pear being inverted in both views and having its small end downwardly disposed. The spindle has its axis at right angles to the barrel which is also the motor axis and the long axis of the pear shaped body coincides with the spindle axis. The chuck 16 is in the small end of the pear, and the large end of the pear is of spherical contour about the upper end of the spindle presenting a ball like grip for the hand at the upper end of the spindle and closing the end of the barrel which is of substantially the same radius as the large end of the pear.

The head or gear casing 4 may be described in connection with nose 16 as in the form of an elbow continuous with the front end of the barrel which is treated as horizontal the elbow housing a downwardly reducing taper. The convex portion of the turn of the elbow is also regarded as of ball like formation affording a satisfactory palm grip the fingers extending downwardly over the nose which constitutes the reduced end of the taper.

The term zone as used herein has reference to a band shaped area of the nose surface extending around the same at right angles to the nose axis.

In order to illustrate the size and proportions of the casing, this casing with other parts is drawn full size, particularly in Figures 1 and 2, the gear casing as shown being over three inches from its back surface at 25 in line with the drill axis to the end of the nose at 26, and approximately two and one quarter inches in width from 27 to 28 in Figure 3, it being understood that these dimensions are subject to variation though the dimensions shown are regarded as most convenient for the average operator, particularly for the one-handed support and control of the tool.

In accordance with the preferred arrangement, the chuck 16 is mounted directly on the lower end of the tool spindle 22 and has a threaded connection at 11 with a ring 12 which has a central bearing boss 10 which is threaded into the gear casing 4 at 14, the nose 15 which encloses the chuck 16 in a manner to be described being threaded into the gear casing 4 at 17.

The tool of the invention is particularly adapted to be grasped and directed by and with one hand of the operator, it is also to be noted that it may be supported and directed by both hands grasping the barrel or the motor casing and that, when thus held, work can be performed under some circumstances in even more confined spaces than when the tool is supported and directed by one hand grasping the gear casing as shown in Figures 10 and 11. The ability to support and direct the tool by and with one hand, however, has important advantages as already suggested. Some of the features described are independent of the type of motor. The usual practice provides that the electric motor be ventilated by means of a fan which passes air around
the motor, the air being introduced through a series of holes at one end of the casing and exhausted through a corresponding series of holes at the other end of the casing, one set of holes being at the end of the field casing in the vicinity of the gear casing. An important difficulty encountered in the development of the present tool has been due to the fact that in grasping the tool about the gear casing as shown in Figure 6 the latter mentioned set of ventilating holes is completely or almost covered so that the ventilating air is cut off from the motor and heating results. To overcome this difficulty the applicant has provided the ventilating system illustrated in the preferred form in Figures 1 to 5 and in a modified form in Figures 6, 7, 8, and 9. In accordance with this system, the air may be forced or projected by the fan 6 through annularly arranged openings 8 and 9 which lead from the fan chamber 51 to the annular discharge 52 at the left or forward edge of the ring 12, which ring is an extension of the field casing 2, which is provided for convenience of construction in this form of the tool, and is omitted or made integral with the field casing in other forms shown. The draft openings 8 and 9 extend substantially around the casing circumferentially of the motor shaft providing a passage around the entire periphery of the casing including a slot 45 at the bottom adjacent to nose 15. To prevent cutting off of the air draft in case the hand, in holding the tool, covers a large portion of the peripheral draft opening 32 or any similar draft opening, the surface of the gear casing 4 is grooved or corrugated, the corrugations or grooves 5, in the preferred form shown, extending from the peripheral draft opening 32 in any suitable arrangement along the surface of the casing and being to best advantage turned from a direction parallel to the motor axis at 35 downwardly at 30 so that they approach the direction of the bit axis and the axis of the tool spindle which is at right angles to the motor axis. The exact angle of the bit axis and spindle axis is subject to variation if desired, the right angle relation being preferred for convenience in driving. The arrangement of the grooves 5 as shown provides a free discharge for the ventilating air under all circumstances of holding, as suggested in Figure 10, and also provides for the cooling of the gear casing, which is an important advantage, particularly in operating the tool when directed and supported by and in one hand with the gear casing gripped as described or in some similar manner. The slot 32 would not be covered at any time.

While the fan 6 has been described as discharging air toward the gear casing, the vacuum thus created serving to draw through the motor air which is introduced at the openings 1, a change of the angle of the fan blades which would cause the air to be drawn in through the gear casing 4, passed through the motor and discharged by way of the openings 1, is a non-inventive variation which is contemplated, the direction of the draft being a matter of selection.

Figure 8 shows a modified form of the tool in which the air draft is propelled by the fan 40 on the shaft 41 of the motor 42 is released or admitted by way of a series of holes 43 suitably arranged about the gear casing 44, and, further, by way of a slot 45 of any convenient shape at the bottom of the casing, preferably discharging adjacent the nose 46 preferably enclosing the chuck 47 in the manner previously described, it being further understood that the holes 43 may be of any suitable shape and in any suitable arrangement about the gear casing, the purpose being to avoid closing these holes or the majority of them when the gear casing is gripped by the hand after the manner illustrated in Figure 10 or in any manner suitable to the supporting and directing of the tool by one hand of the operator. In this connection, slot 45 being of large dimensions in comparison to the holes 43 serves to release a large portion of the air necessary to cool the motor, giving effective cooling when the holes 43 are partially covered, the draft through holes 43 being, however, sufficient to cool the gear casing 44. The holes 43, as shown, are preferably inclined outwardly and forwardly away from the fan, being connected to the fan chamber 46 by a series of corresponding holes 48 drilled in the rear wall 49 of the gear casing, being parallel to the motor axis or at any suitable angle, it being understood that the arrangement shown is chosen largely for convenience in the formation of the holes by drilling, which contributes to low cost production. It may be further noted that the air is fed to or from the slot 45 by the entrance and exit of the holes 43 as shown in Figure 7. In this connection, it is to be understood that the draft passages 43, 48, and 45 are subject to considerable variation and that the blades 50 of the fan 48 may be inclined at any suitable angle to pass the air either in the direction shown; i.e., drawing it into the casing by way of the openings 51, passing it over the motor to the left, and discharging it by way of the holes 43 and the slot 45, or in the opposite direction, so that it is drawn in at 43, 45 and passed to the right through and about the motor and discharged at 51. While the cooling of the gear casing and motor in this or some equivalent manner is of great advantage, the other features of the invention may be utilized without this provision.

The gear connections not shown may be arranged in any suitable manner, the connections shown in Figure 4 being suitable to the various types of tool illustrated.

In the form of casing shown in Figure 6, the ring 12 of the previous construction has been omitted, the casing consisting of the instance of the field or motor casing 53, constituting the main feature of the barrel, the brush and switch housing 54, and gear casing 44. The latter, in the most highly developed form, has a nose 46, chambered to receive the chuck 47. The nose 46, as previously described, provides an engagement for the fingers immediately adjacent the bit shank for directing the drill or other bit 13, as shown in Figure 10. While this arrangement of nose and chuck is of great advantage, the other features of the invention may be otherwise associated.

The casing members 44 and 53, have a threaded engagement at 55 as already suggested in connection with the construction previously described, obviating use of screws or bolts in connecting these elements of the invention, this and other details being subject to wide variation.

Figures 8 and 9 show still another form of the tool in which the motor 60 is ventilated by passages 81 leading directly from the rear face 82 of the gear casing 84 through the same to its forward curved surface at 85, the said passages 81 being preferably of elongated cross section. The elongated sides 86 of these openings are preferably curved concentrically with the motor axis as shown in Figure 9, or this may be referred to

End of Document.
It is to be further noted that the tool described is of particular advantage among other uses to which it may be applied in assembling the frames of airplane wings and the like, as shown at 75 in Figure 11, where it is necessary to oper 5
ate a drill or nut runner between the struts 76 and 10
inside the wings, and hence in localities which are 15
closey restricted as to the dimensions of any tool 20
which can thus be employed. In many instances 25
it can be employed where hand operations were 30
formerly necessary, being adapted to all classes of 35
rotary tool work.
I have thus described a portable rotary electric 40
tool embodying the features of my invention in 45
the preferred and in certain modified forms, the 50
description being specific and in detail in order 55
that the manner of constructing, applying, oper 60
ating, and using the tool may be understood; 65
however, the specific terms herein are used de 70
scriptively rather than in a limiting sense, the 75
scope of the invention being defined in the 80
claims.
What I claim as new and desire to secure by 85
Letters Patent is:
1. A portable, power-driven rotary tool for use 90
in assembling and similar work particularly in 95
confined spaces comprising a barrel and a head 100
at one end of the barrel, said head having spindle 105
bearings and a spindle therein substantially at 110
right angles to the barrel axis, and a nose at one 115
end of said spindle encircling the spindle and 120
integral with the head, the head being of a size 125
and proportion and being adapted to be enclosed 130
within the palm of the hand with the finger ends 135
engaging the nose to support and direct the tool, 140
the nose being chamfered to receive and contain 145
a chuck on the end of the spindle, the barrel 150
being adapted to contain a motor for driving 155
spindle through angular connections in said head, 160
and the head being rigidly connected to the 165
casing.
2. A portable power-driven rotary tool for use 170
in assembling and similar work particularly in 175
confined spaces having an electric motor, a field 180
casing therefor, a gear casing rigidly secured to 185
and substantially closing an axial end of the 190
field casing, a spindle in the gear casingsubst 195
stantially at right angles to the motor axis, 200
the gear casing having a smoothly curved convex 205
external surface surrounding and engaging the 210
upper end of the spindle and adapted to fit in 215
the palm of the hand and to be gripped by one 220
hand, whereby the tool is adapted to be directed 225
and supported by one hand of the operator, a 230
chuck on the opposite end of said spindle, the 235
gear casing having a finger grip surrounding the 240
spindle, and of less diameter than the said upper convex surface of the gear casing, and rigidly attached thereto, the said grip being adjacent the chuck and adapted to be engaged by the fingers of the hand which encloses the gear casing.

5. A casing for a portable rotary electric tool for use in assembling and similar work particularly in confined spaces comprising a barrel adapted to enclose a motor having its axis parallel to the barrel axis and a head closing the front end of the barrel and provided with bearings to support a spindle transverse to the motor axis, the said barrel having a ball like rounded external surface surrounding the upper end of the spindle, the same being shaped and proportioned to serve as a one-hand grip, whereby the tool is adapted to be supported and directed by one hand of the operator, the barrel having air passages and the head being provided with air passages in its surface continuous with the air passages in the barrel for ventilating the casing and head, the air passages in the head comprising openings spaced away from the area contacted by the hand in gripping the head.

5. A casing for a portable electric tool for use in assembling and similar work particularly in confined spaces comprising a barrel adapted to support an electric motor with its axis extending substantially in the direction of the axis of the casing, a gear casing secured to the end of the field casing and adapted to support a spindle substantially at right angles to the motor axis, the gear casing being pear shaped with the axis of the pear coinciding with the axis of the spindle, the gear casing being pear shaped in the palm of the hand of the operator and having the palm-engaging portion which is the large end of said pear shaped casing smoothly rounded for this purpose, and substantially enclosing the upper end of the spindle and a finger-grip portion at the lower end of said spindle, said finger grip being rigidly supported on the gear casing, and adapted to be engaged by the fingers of the hand which encloses the gear casing, the gear casing having ventilating passages and the field casing having ventilating passages and other ventilating means adapted to cooperate therewith to ventilate the gear casing and the field casing, the ventilating passages in the gear casing comprising grooves in the surface of said casing, inclined to the direction of the axis of the gear casing and connected to the passages in the field casing.

8. A portable power driven rotary tool particularly adapted for use in assembling work, and for operation in confined spaces, the same having a casing, comprising a barrel in the nature of a field casing for an electric motor, and a head closing one end of the casing, the head being rigidly secured and having spindle bearings and a spindle therein at right angles to the barrel axis, the head being in the form of an elbow, one arm of which is continuous with the barrel, the elbow having a ball like convex bend, the ball like portion overlying and with the adjacent end portion of the barrel surrounding the upper end of the spindle, the other arm of the elbow having a reducing taper downwardly from said ball like portion, the tapered portion being in the nature of a nose surrounding the lower end of the spindle and being rigidly secured to the head and chambered to contain a chuck on the end of said spindle, the ball like portion being adapted to fit in the palm of the hand, the fingers engaging the nose whereby the tool is held and directed in and by one hand.

9. A portable power driven rotary tool for use in assembling and similar work particularly adapted for operation in confined spaces, the same comprising a barrel having a motor therein and a head rigidly secured to the barrel at one end, said head having spindle bearings and a spindle therein transverse to the barrel axis and a nose at the lower end of said spindle encircling the spindle and rigidly supported relatively to the barrel, the head being of rounded ball-like shape about the upper end of the spindle and of a size and proportions adapted to be enclosed within the palm of the hand with the finger ends extending over and engaging the nose to support and direct the bit, the nose being chambered to receive and enclose a chuck on the lower end of said spindle whereby the fingers are protected from contact with the chuck as it rotates and the motor having a driving connection with said spindle.

10. A portable power driven rotary tool for use in assembling and similar work particularly adapted for operation in confined spaces, the same comprising a barrel having a motor therein and a shaft driven by the motor, said barrel rigidly supported on the barrel, said head having spindle bearings and a spindle therein transverse to said
shaft, which has a driving connection to said spindle, a nose at the lower end of said spindle encircling the spindle and rigidly supported, the head being of rounded ball-like shape about the upper end of the spindle and of size and proportions adapted to be enclosed within the palm of the hand with the fingers extending over and engaging the nose to support and direct the bit, the nose being chambered to receive and enclose a chuck on the end of said spindle whereby the fingers are protected from contact with the chuck as it rotates.

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