Sept. 22, 1964 A. W. DREW **3,149,681**

ROTARY IMPACT HAMMER

Filed Jan. 14, 1963 2 Sheets-Sheet 1

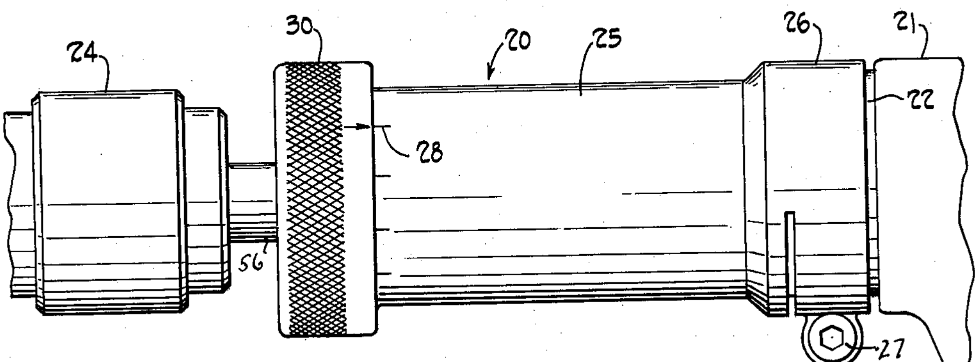

FIG. 1

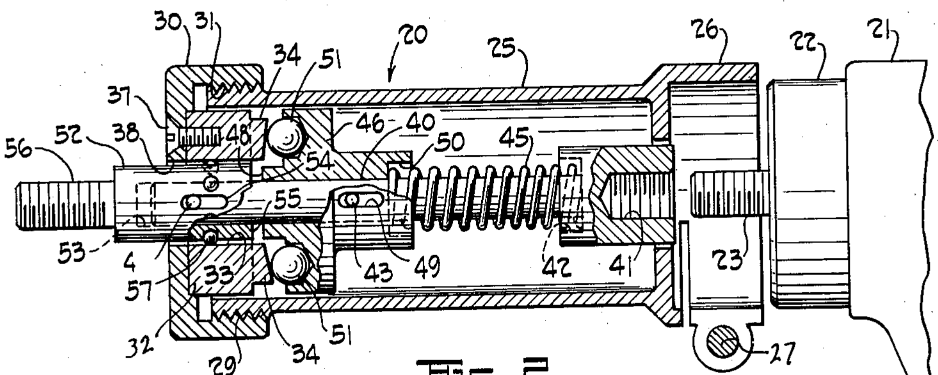

FIG. 2

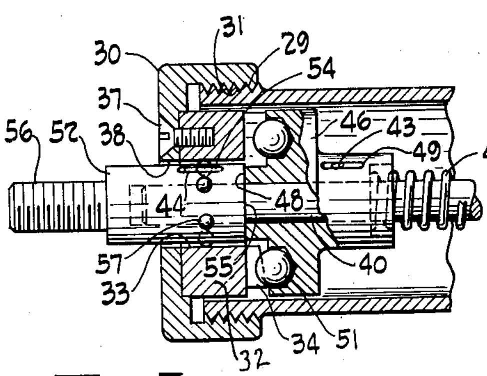

FIG. 3

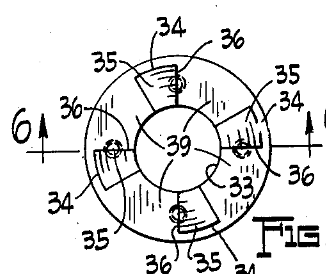

FIG. 5

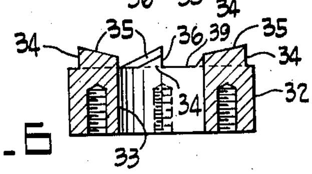

FIG. 6

INVENTOR.
AMBROSE W. DREW
BY
Sanford Schumacher
ATTORNEY.

Sept. 22, 1964 A. W. DREW 3,149,681

ROTARY IMPACT HAMMER

Filed Jan. 14, 1963 2 Sheets-Sheet 2

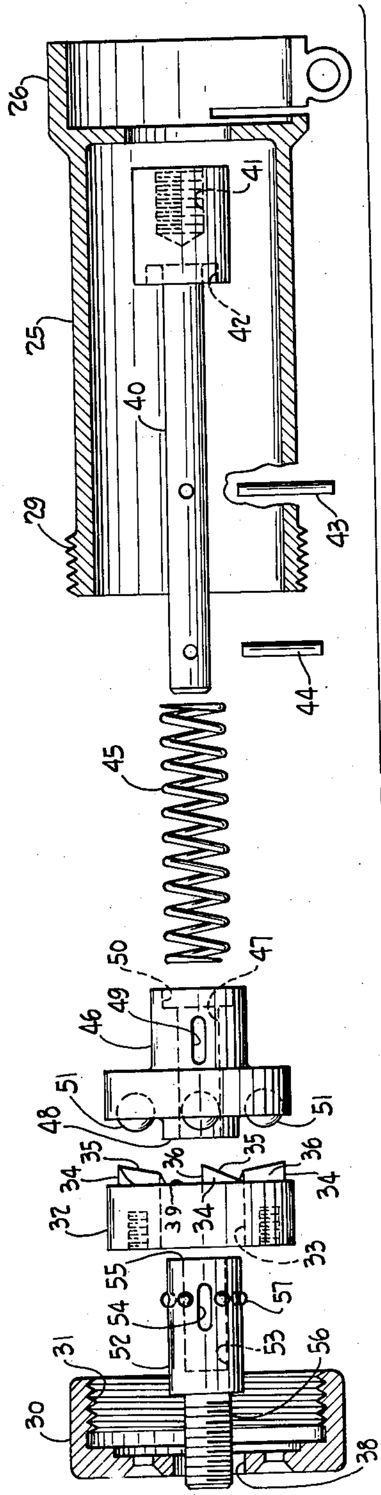

Fig. 4

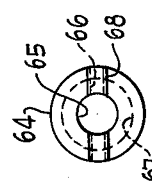

Fig. 9

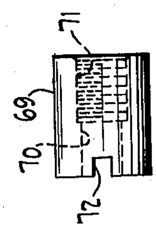

Fig. 11

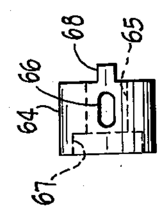

Fig. 8

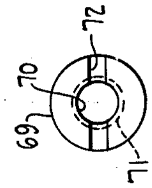

Fig. 10

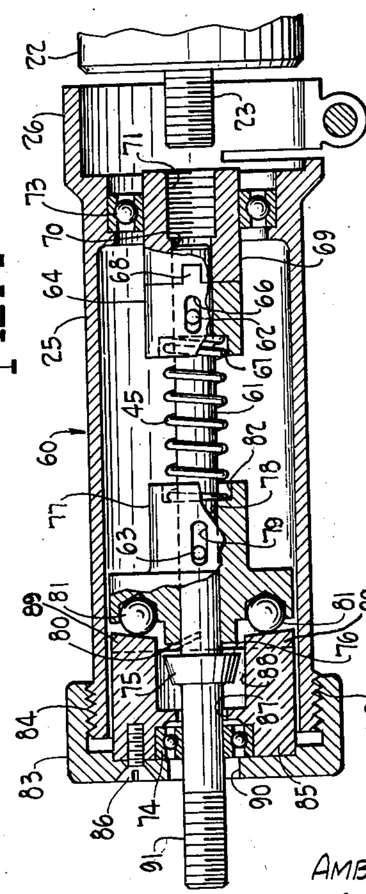

Fig. 7

INVENTOR.
AMBROSE W. DREW

BY

Sanford Schmurmacher
ATTORNEY.

United States Patent Office

3,149,681
Patented Sept. 22, 1964

3,149,681
ROTARY IMPACT HAMMER

Ambrose W. Drew, 2183 Campus Road, Cleveland, Ohio

Filed Jan. 14, 1963, Ser. No. 251,180
2 Claims. (Cl. 173—97)

This invention relates generally to tools and is more particularly concerned with a rotary hammer device for simultaneously rotating and axially impacting a tool bit and other member.

Conducive to a better understanding of the invention, it may be well to point out that tools of this type have a common defect in that they are subject to excessive heating, due to friction generated between the impacting elements which comprise a rotating anvil portion against which a non-rotating hammer is repeatedly driven. Since the anvil and its shaft are ordinarily operated at speeds of 1800 r.p.m., it will be evident that even during the short period of impact there is a substantial frictional drag between the stationary and rotating parts.

To reduce the heating effect, various schemes of lubrication, cooling oil circulation, and heat dissipating fins have been used.

The primary object of this invention, therefore, is to provide a rotary impact hammer whose anvil and hammer elements rotate together and impact, without relative rotation, in friction free engagement.

Another object is to provide a device of the type stated whose tool holding element is free to move axially of its center of rotation under impact.

A further object is to provide a rotary hammer mechanism for rotating a drill bit, or the like, and simultaneously applying frictionless axial impacts thereto, which device is simple in construction, fully adjustable as to the force of the delivered impact, heat free in operation, and relatively inexpensive to manufacture.

These and other objects of the invention will become apparent from a reading of the following specification and claims, together with the accompanying drawings, wherein like parts are referred to and indicated by like reference numerals, and wherein:

FIGURE 1 is a side elevation of the rotary impact hammer that is the subject of this invention;

FIGURE 2 is a side elevation, partly in section of the rotary hammer device with the cam members shown in one position of engagement;

FIGURE 3 is a sectional view of the forward end of the device showing the cam members thereof in another position of engagement;

FIGURE 4 is an exploded view of the device;

FIGURE 5 is a right end view of the stationary cam track illustrated in FIGURE 2;

FIGURE 6 is a cross-sectional view taken along the line and in the direction of the arrows 6—6 of FIGURE 5;

FIGURE 7 is a longitudinal sectional view of an alternate form of the device;

FIGURE 8 is a side view of the spindle coupling sleeve, illustrated in FIGURE 7;

FIGURE 9 is a right end view of the same;

FIGURE 10 is a left end view of the drive shaft engaging half of the coupling unit; and

FIGURE 11 is a side elevation of the same.

Referring more particularly to the drawing, there is seen in FIGURE 1 the rotary impact hammer that is the subject of this invention, broadly indicated by reference numeral 20, mounted on a conventional portable electric drill case 21, having a shoulder 22 at its motor drive shaft 23, as is seen most clearly in FIGURE 2.

An elongated, hollow housing 25 is mounted on the motor case shoulder 22 through a collar 26, which is

fitted over the shoulder 22 and clamped thereon by means of a bolt 27, as seen in FIGURE 1.

The housing 25 is threaded at its forward end 29 and a cam cap 30, having internal threads 31, is mounted on the housing threads 29, and rotatable thereon. The cap 30 has a centered hole 38 therethrough.

A cam ring 32 is mounted inside the cap 30 by means of screws 37. The cam ring 32 also has a central bore 33 surrounded by a series of sharply inclined and spaced cam teeth 34 rising to an abruptly vertical end face 36. The lands 39 between succeeding teeth 34, as seen most clearly in FIGURE 5, being perfectly flat and of a width greater than the diameter of the cam-follower balls 51 of the hereinafter described hammer 46. The camming surface 35 of each tooth being tapered downwardly crosswise thereof, between its outer edge to its inner edge at the center bore 33, as is seen most clearly in FIGURE 6.

Reference numeral 40 indicates a rotating spindle mounted on the threaded end of the motor drive shaft 23, through a threaded socket 41, and forming a continuation thereof. The forward bearing of the motor shaft 23 acting as a journal to support the spindle 40 in the housing 25. The so mounted spindle 40 extends through the housing 25 and beyond the end cap 30.

Reference numeral 52 indicates a cylindrical anvil having a central blind bore 53 therein, which is slidably fitted over the free end of the spindle 40 within the aligned bores 38 and 33 of the housing cap 30 and cam ring 33. The anvil cylinder has a pair of opposed, elongated, slots 54 cut therethrough which are engaged by a pin 44 mounted through the spindle 40 which serves to lock the anvil 52 to the spindle 40 for positive rotation therewith, but free for axial movement thereon the length of the slots 54.

Reference numeral 57 indicates a ring of bearing balls mounted around the periphery of the anvil 52 and acting to journal the anvil in the cam ring bore 33 for free rotative and reciprocating movement therein.

The so mounted anvil has an annular strike face 55, faced inwardly, and an outwardly extending threaded stud 56, on which the tool holding means, such as a chuck 24, may be mounted, as seen in FIGURE 1.

Reference numeral 46 indicates a cylindrical hammer slidably mounted on the spindle 40 between the anvil 52 and the mounting end 41 of the spindle.

The hammer has a central bore 47 therethrough which receives the spindle in a free sliding fit.

A pair of opposed, elongated, slots 49 in the hammer wall are engaged by a pin 43 mounted through the spindle 40, which acts to keep the hammer locked to the spindle for positive rotation therewith, but free to reciprocate axially thereof, the length of the slots 49.

The hammer has an annular head portion 48 faced toward and engageable with the strike face 55 of the anvil 52.

Four spaced cam follower balls 51 are mounted on the hammer around the head 48 and adapted to ride upon the 4 cam track teeth 34, in co-operative engagement.

The length of the slots 54, of the anvil 52, is such that the pin 44 engaged therewith, will hold the strike face 55 of the anvil 52, .020″ to .030″ inwardly of the surface of the lands 39 between the cam teeth 34, when the anvil 52 is fully advanced, under impact by the hammer head 48.

Therefore the cam balls 51 can never ride upon or touch the land surfaces 39, since they are positioned inwardly of the end surface of the hammer head 48, as seen most clearly in FIGURE 4, and can never approach within .020″ or .030″ of the lands 39 of the cam track.

There can be no etching or galling of the balls 51, as they only make contact with the teeth 35 and never touch or ride on the lands 39, therebetween. This does away with the cause of 50% to 60% of the heat generated at this point by prior art devices.

A helical spring 45 is mounted on the spindle 40 in seated engagement with grooves 42 on the spindle and 50 on the hammer, as seen in FIGURE 2. The spring 45 acts to normally bias the hammer and its cam-follower balls 51 against the cam track teeth 34 and toward the anvil 52.

A study of FIGURE 2 will show that the anvil 52 and the hammer 46 are free to slide axially of the spindle, toward and away from each other, but are keyed to the spindle 40, by means of pins 44 and 43, respectively, against rotation relative to each other.

Thus, they may make contact only through linear movement with no sliding or wiping contact that could create friction between the hammer and anvil.

Rotation of the spindle 40, in the housing 25, causes the hammer balls 51 to ride along the cam track formed by the circularly arranged cam teeth 34, as described hereinbefore.

The inclined camming surfaces 35 of the teeth cause the cam follower balls 51 and the hammer 46 on which they are mounted to move axially of the spindle 40, away from the anvil 52, against the biasing action of the spring 45, thereby causing the spring 45 to be compressed, as shown in FIGURE 2. When further rotation of the spindle 40 carries the cam follower balls beyond the end walls 36 of the cam teeth 34, the spring 45 expands to drive the hammer head 48 axially of the spindle 40, in sharp impact against the strike face 55 of the anvil 52, as seen in FIGURE 3. Since both the hammer and anvil rotates with the spindle then contacting surfaces, that is the head 48 of the hammer and the strike face 55 of the anvil, are motionless relative to each other and therefore no heat creating friction is developed.

Again, due to the fact that the anvil 52 is keyed to the spindle through the slot 54, the anvil, with its retained tool, is free to move axially of the spindle 40 under impact from the hammer head 48. Thus a true hammering action is obtainable with this device and not a mere vibrating action, such as is the case when no axial movement of the held tool is possible under the impact of the hammering element.

The strength of the impact of the hammer can be varied between limits of maximum impact and no impact at all by rotating the cam cap 30 between spaced markings 28 on the housing exterior, as seen in FIGURE 1.

The lateral tapering of the camming surfaces 35 of the cam teeth 34 causes the cam follower balls 51 to be urged toward the spindle 40, thereby counteracting any tendency for the hammer 46 to be tilted out of alignment with the spindle 40 by the thrust between the cam follower balls 51 and the camming surfaces 35 of the cam teeth 34.

The required degree of lateral taper varies directly with the diameter of the cam follower balls 51, being least with small balls.

FIGURES 7 to 11, inclusive, show a modification of the device, broadly indicated by reference numeral 60, wherein the spindle 61, itself, is capable of axial movement relative to the housing 25, to provide a true hammering reaction on the held tool, not shown.

In this form, the cam cap 83 is similarly mounted through threads 84 on the threaded end 29 of housing 25, to provide progressive adjustment for the cam ring 85 which is secured to the cap 83 by means of screws 86.

The cap 83 has a central opening 90. The cam ring 85 has a shouldered bore 87 which holds a bearing unit 74, and also has a counter bore 88 at the inner end thereof.

A coupling sleeve 69 is journaled in bearing 73 at the inner end of the housing 25. The sleeve 69 has a bore 70 therethrough which is threaded at one end 71 to engage the threaded end of the motor drive shaft 23. The other end of the sleeve 69 has a diametrical slot 72 cut thereacross.

Reference numeral 61 indicates a spindle which is journaled at its inner end in the bore 70 of coupling sleeve 69, and at its other end in the cap bearing 74 through which it extends to protrude beyond the cap 83.

The free end 91 of the spindle is threaded to receive a tool holding device, such as a drill chuck, not illustrated.

A second coupling sleeve 64, having a diametrically disposed upstanding key 68, which mates with slot 72 of the motor coupling sleeve 69, is mounted on the spindle 61, which extends in a free sliding fit through its central bore 65.

The sleeve 64 has a pair of aligned longitudinally extending slots 66 cut through the walls thereof, which are engaged by a pin 62 mounted through the spindle 61 and which acts to lock the sleeve 64 and spindle 61 against relative rotation but leaves the spindle free to reciprocate axially in the sleeve bore 65, the length of the slots 66.

It will be seen from a study of FIGURE 7 that there is no direct connection between the spindle 61 and the motor drive shaft 23, so that the spindle 61 is free to reciprocate in the two coupling sleeves 64 and 69, toward or away from the drive shaft 23.

Reference numeral 75 indicates an anvil, having a strike face 76, which may be either formed integral with the spindle or may be a separate piece, immovably mounted thereon.

The anvil 75 is located within the counter bore 88 of the cam ring 85.

The cam ring 85 has four cam track teeth 89 similar in size and contour to those described with the embodiment indicated by reference numeral 20.

A hammer 77 is slidably mounted, through a central bore 78, on the spindle 61, inwardly of the cam ring 85.

The hammer has 4 cam follower balls 81 imbedded therein which operate co-operatively with the teeth 89 of the cam 85.

An annular head 80 is positioned on the hammer, faced toward and aligned with the strike face 76 of the anvil 75.

An elongated slot 79, cut through the opposed walls of the hammer, is engaged by a pin 63 mounted through the spindle 61. The pin 63 acts to lock the hammer and spindle against relative rotation, but leaves the hammer 77 free to reciprocate longitudinally of the spindle, the length of the slot 79.

The hammer 77 is normally biased toward the anvil strike face 76 and in contact with the cam teeth 89 by a spring 45 anchored at one end in a groove 67 in the coupling sleeve 64 and seated at its other end in a second groove 82 in the hammer 77.

It will now be evident that the anvil 75 and the hammer 77 rotate with the spindle 61 and at the same speed as the spindle. As a result, when the hammer head 80 is impacted against the anvil strike face 76, by the co-operative action of the camming components together with the biasing action of the spring 45, there is no wiping or sliding action between the anvil and hammer to create friction.

Therefore the device will remain cool even after prolonged operation.

Since the spindle 61 is slidably mounted through the coupling sleeve 64, at the moment of impact, the spindle and anvil are free to move axially away from the hammer head to carry the tool retained on the spindle end 91 forward in the direction of the impact blow, thereby providing a true hammer impact as was the case with the first embodiment of the device, identified by reference numeral 20.

The only difference being that in this instance there is axial movement of the spindle 61 itself, while in the first embodiment, the tool holding cylindrical anvil 52 is moved axially of the spindle 40 under impact from the hammer head 48.

It will now be clear that there has been provided a device which accomplishes the objectives heretofore set forth.

While the invention has been disclosed in a preferred and an alternate form, it is to be understood the specific embodiments thereof as described and illustrated herein are not to be considered in a limited sense, as there may be other forms or modifications of the invention which should also be construed to come within the scope of the appended claims.

I claim:

1. In combination with a portable electric drill of the type having a case and a drive shaft protruding therefrom, a rotary impact hammer, comprising, an elongated hollow housing mounted on the case at the drive shaft; a spindle journaled in the housing for rotary and limited axial movement relative to the housing and extending through the forward end thereof; coupling means on said spindle within said housing for connection to the motor drive shaft; anvil means comprising a shouldered collar positioned on the spindle intermediate its ends; hammer means slidably mounted on and keyed to the spindle for rotation therewith and movement axially thereof between a first position, in engagement with the spindle anvil, and a second position, spaced from the anvil; spring means mounted on the spindle in pressed engagement with the hammer for normally biasing the hammer to its first position; and

cooperating cam means on said hammer and housing for alternately moving the hammer between its first and second positions for imparting impact to the spindle anvil along its axis of rotation when the spindle is rotated in the housing, said cooperating cam means comprising a plurality of circumferentially arranged camming portions on an end face of the hammer, and rotating therewith, and a plurality of cooperating circularly arranged camming portions on the housing and held stationary thereby.

2. A rotary impact hammer according to claim 1, wherein the coupling means comprises a slotted sleeve journaled in the housing having an axial socket for loosely receiving the end of the spindle therein, the latter having a pin therethrough engaged with the sleeve slot to allow limited axial movement of the spindle relative to the sleeve, while holding the sleeve and spindle against relative rotation.

References Cited in the file of this patent

UNITED STATES PATENTS

1,665,173	Misener	Apr. 3, 1928
2,191,608	Coates	Feb. 27, 1940
2,869,374	Morris	Jan. 20, 1959
2,947,180	Oros	Aug. 2, 1960
2,974,533	Demo	Mar. 14, 1961
3,107,083	Pewthers	Oct. 15, 1963