

May 19, 1964

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IMPACT DRILL

3,133,602

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2 Sheets-Sheet 1

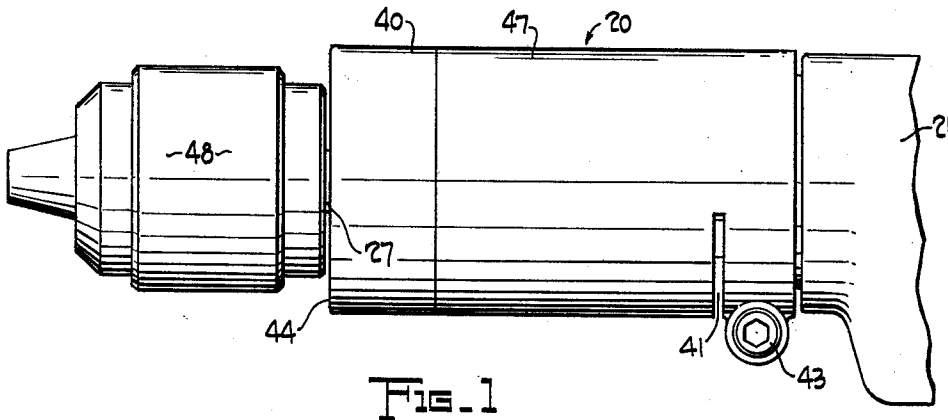


FIG. 1

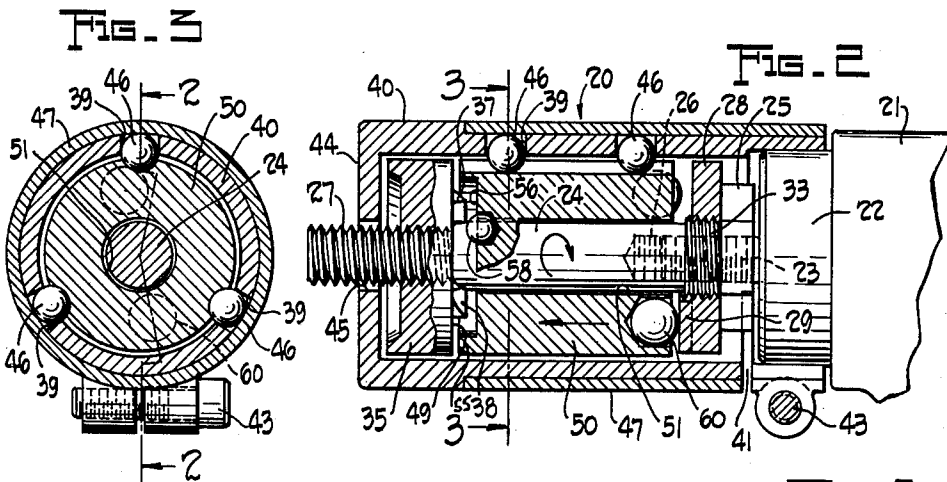


FIG. 2

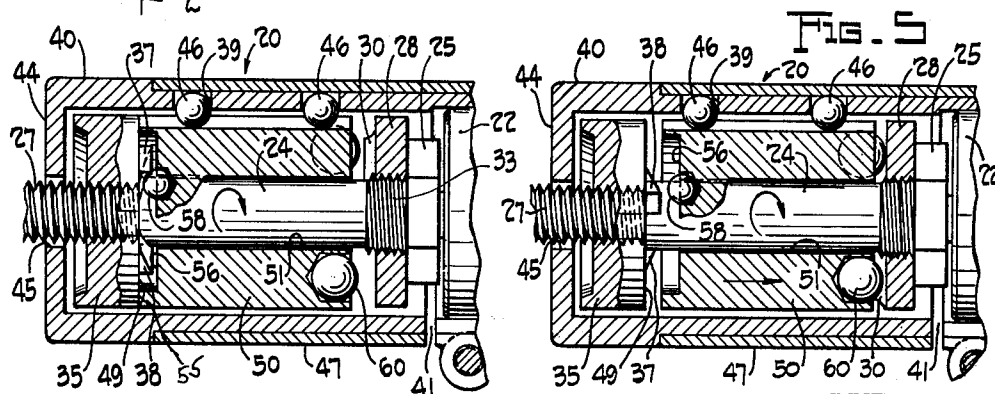


FIG. 3

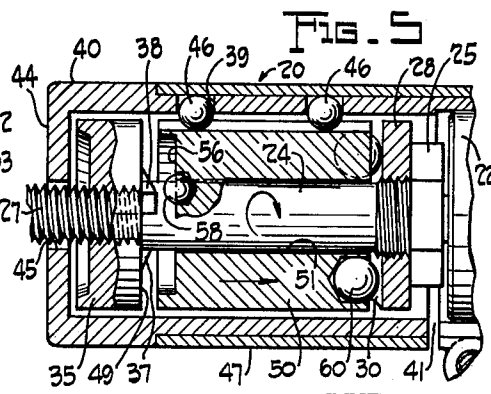


FIG. 4

FIG. 5

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2 Sheets-Sheet 2

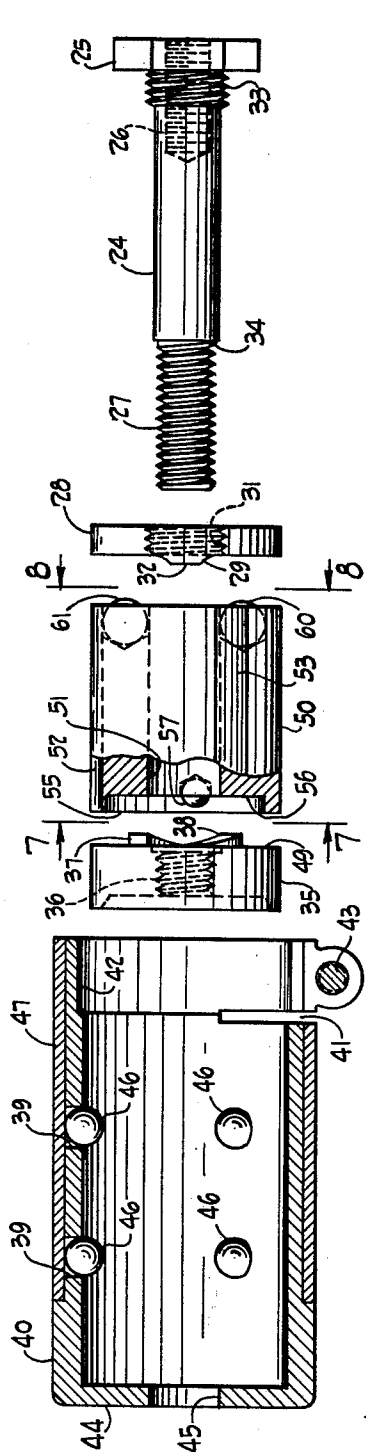


FIG. 6

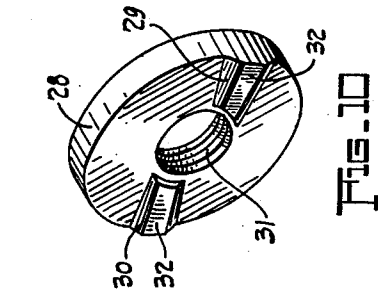


FIG. 10

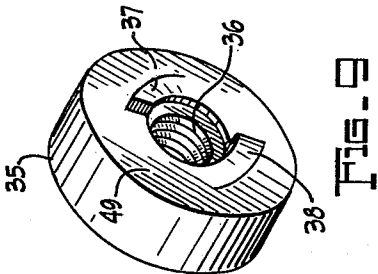


FIG. 9

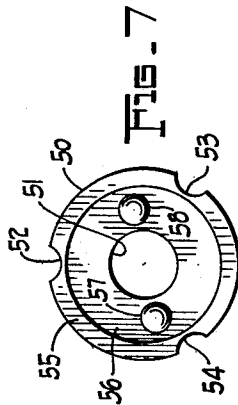


FIG. 7

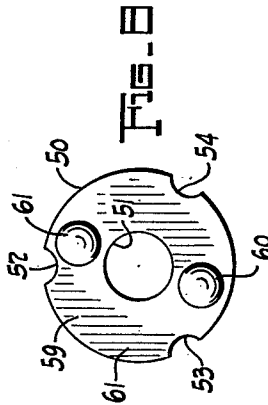


FIG. 8

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1

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IMPACT DRILL

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This invention relates to impact drills and particularly to a drill having a free floating hammer.

Conducive to a better understanding of the invention, it may be well to point out that prior art automatic impact drills employ spring biased hammer elements slidably mounted on a rotating tool holding spindle. The inter-action between the rapidly rotating spindle and the reciprocating spring biased hammer quickly creates a great deal of frictional heat which limits the proper operation of such devices to relatively short periods since the heated parts expand and freeze, or become uncomfortably hot to hold unless time out is taken, periodically, to permit the drill to cool.

The primary object of this invention, therefore, is to provide an impact drill having a reciprocating hammer that floats free and clear of the spindle, without frictional contact therewith.

Another object is to provide an impact drill whose hammer is free to reciprocate longitudinally of the spindle and is moved without the use of any biasing spring.

A further object is to provide an impact drill of the type stated, having a free floating massive hammer that is thrown between two spaced cam elements rotating with the spindle.

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

FIGURE 1 is a side elevational view of the impact drill that is the subject of this invention;

FIGURE 2 is a longitudinal sectional view, taken along the line and in the direction of the arrows 2-2 of FIGURE 3, showing the free floating hammer in a first position;

FIGURE 3 is a cross-sectional view of the same, taken along the line and in the direction of the arrow 3-3 of FIGURE 2;

FIGURE 4 is a longitudinal sectional view showing the floating hammer in a second position;

FIGURE 5 is a longitudinal sectional view showing the hammer in a third position;

FIGURE 6 is an exploded view of the device;

FIGURE 7 is a left end view of the hammer taken along the line and in the direction of the arrows 7-7 of FIGURE 6;

FIGURE 8 is a right end view of the hammer taken along the line and in the direction of the arrows 8-8 of FIGURE 6;

FIGURE 9 is a perspective view of the anvil cam disc; and

FIGURE 10 is a perspective view of the hammer throwing disc.

Referring more particularly to the drawing, there is seen in FIGURE 1 the impact drill that is the subject of this invention, broadly indicated by reference numeral 20.

Reference numeral 21 indicates the housing of a conventional electric drill having a threaded motor shaft 23 centered in an end collar 22.

Reference numeral 40 indicates a hollow cylindrical case having an open rear end, recessed at 42, to fit over the motor housing collar 22.

The case is slotted at 41 to define a strip to permit the rear end of the case to be flexed and clamped on to the motor collar 22 by means of a clamping bolt 43.

2

The case 40 has a front wall 44 with a central axial opening 45 therethrough, and 3 sets of spaced and paired, free turning bearing balls 46 seated in bores 39 in the side wall thereof, spaced 120° apart, as is seen most clearly in FIGURES 3 and 6.

A sleeve 47 fits over the case 40 to keep the bearing balls 46 in place.

A spindle shaft 24 is mounted through a threaded bore 26 on the end of the shaft 23, forming an extension thereof, as seen in FIGURE 2.

The spindle 24 extends through the housing 40 with its end 27 protruding through the opening 45 thereof. The spindle 24 is supported solely by the motor shaft 23 and is clear and free of the case 40 and the walls of the opening 45 thereof.

Reference numeral 28 indicates a first, or hammer throwing disc mounted on the spindle 24 through a threaded bore 31 which engages external threads 33 on the motor end of the spindle. This disc is locked in place by a nut 25.

The disc 28 has two diametrically aligned cam teeth 29, and 30, having a wide flat top surface 32.

The camming surface of the teeth 29 and 30 are steeply inclined, for a purpose to be hereinafter disclosed.

A second, or anvil disc 35 is mounted on the threaded end 27 of the spindle 24 against shoulder 34, through a central threaded bore 36.

The disc 35 has two diametrically aligned cam teeth 37 and 38 with gradually inclined surfaces, for a purpose to be hereinafter disclosed.

Reference numeral 49 indicates a flat anvil surface which surrounds the cam teeth 37 and 38, as is seen most clearly in FIGURE 9. The two discs 28 and 35 are thus spaced apart on the spindle 24 with their respective cam teeth 29, 30 and 37, 38 faced toward each other with the high point of cam teeth 37, 38 positioned slightly ahead, approximately 20°, of the projected plane of the cam teeth 29, 30 as they rotate together with the spindle 24.

The diameters of the two discs 28 and 35 are such that they clear the inner wall of the case 40 and do not touch the case as they rotate with the spindle 24.

Reference numeral 50 indicates a solid, cylindrical hammer member having an axial bore 51 therethrough and three longitudinal semi-circular slots 52, 53 and 54 spaced 120° apart and adapted to receive the bearing balls 46 to mount the hammer within the base 40, for longitudinal reciprocating movement therein, but secure against rotation.

The hammer end face 59 has two diametrically spaced cam follower balls 60 and 61 seated therein and free to revolve in their retaining sockets.

The striking end 56 of the hammer 50 has two diametrically spaced, freely rotating, cam follower balls 57 and 58, and a peripheral collar 55 which extends beyond the balls, as is seen most clearly in FIGURES 6 and 7.

The two cam follower balls 57 and 58 are positioned at 90° to cam follower balls 60 and 61, at opposite end faces 56 and 59 of the hammer 50, as can be seen in FIGURES 7 and 8.

The hammer 50 is slidably mounted on the core balls 46, over the spindle 24, between the discs 28 and 35, as seen in FIGURES 2 and 3, and is held against rotation by the balls 46.

The hammer 50 rides solely on the core balls 46 longitudinally of the spindle 24, with its axial bore 51 entirely clear of the spindle 24, as is seen most clearly in FIGURE 3.

Reference numeral 48 indicates a tool holding chuck that is mounted on the threaded end 27 of the spindle 24.

In operation rotation of the spindle 24 and the discs 28 and 35 acts to throw the non-rotating hammer 50 back

and forth between the anvil disc 35 and the throwing disc 28.

As seen in FIGURES 2, 4 and 5, spindle 24, which has the tool chuck 48 mounted on its out end, rotates, in a clock-wise direction, as is common with all electric drills.

As the cam teeth 29 and 30 of the throwing disc 28 contact the hammer cam follower balls 60 and 61, respectively, the hammer 50 is pushed sharply, by the steeply inclined cam face of the teeth 29 and 30, to the left until its collar 55 strikes the anvil disc face 49, to take the second position illustrated in FIGURE 4.

As the spindle 24 continues to turn the cam return-throw teeth 37 and 38 of the anvil disc 35 ride against the cam follower balls 57 and 58 of the hammer 50 and throw it back against the disc 28 with its end face 59 positioned against the flat top surface 32 of the cam teeth 29 and 30 of cam disc 28, as seen in FIGURE 5.

Since the cam teeth 37 and 38 are positioned slightly ahead of the projected plane of the throwing disc cam teeth 29 and 30, as stated hereinabove, the hammer face 59 will contact the flat tops 32 of the cam teeth 29 and 30 just before the cam teeth contact the cam-follower balls 60 and 61, as seen in FIGURE 5.

Immediately thereafter, the turning spindle 24 will rotate the cam teeth 29 and 30 of disc 28 against the hammer cam-follower balls 60 and 61 to the position of FIGURE 2, wherein the throwing and return cycle is repeated.

Since the cam teeth 29 and 30 of throwing disc 28 are steeply inclined, the hammer 50 will be thrown rapidly against the anvil surface 49 of disc 35.

However, since the anvil cam teeth 37 and 38 have gradually rising cam surfaces, the hammer 50 is returned relatively slowly against the throwing disc 28.

Thus the major hammering impact is delivered during the trip toward the anvil surface 49 from which the impact is transmitted through the spindle end 27 to a tool held in the chuck 48.

The return movement is relatively slow since its purpose is merely to return the hammer to its first position in readiness for another throw by the cam teeth 29 and 30 of disc 28.

Since the hammer 50 is relatively long, with a large mass it will deliver a smart blow against the anvil disc 35.

The to-and-fro movement of the hammer will be sluggish at low speeds, but at spindle rotations of 500 r.p.m. and above, it becomes positive and vigorous.

It will be noted that there are no large areas of contact between stationary and moving surfaces to build up friction and resultant wasted energy and heat.

The only contact between the hammer 50 and the case 40 is through the free rolling bearing balls 46.

There is no contact between the hammer and the spindle 24. The spindle and its supported discs 28 and 35 make no contact with the case 40.

The entire spindle assembly is mounted on the motor shaft 23, and in effect journaled on the motor bearings.

Thus there are no friction creating sliding surfaces and therefore the device can be used for prolonged periods without heating up.

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 its preferred form, it is to be understood that the specific embodiment thereof as described and illustrated herein is 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 having a housing and a motor driven drive shaft centered in a collar on said housing, an impact drill unit, comprising, a hollow case rigidly mounted at one end on the housing collar; a tool holding spindle mounted on the end of the

drive shaft, forming a continuation thereof, and extending through the case; a tool holding chuck mounted on the spindle end, beyond the case; a cylindrical hammer slidably journaled on the inner wall of the case having cam follower balls embedded in the end faces thereof and an axial bore for clear passage of the spindle therethrough; bearing means mounted on the case wall and engaged with longitudinal slots in the hammer to prevent rotation thereof relative to the case and spindle, but leaving the hammer free to reciprocate on the bearing means longitudinally of the spindle between spaced and opposed cam discs rigidly mounted on the spindle on opposite sides of the hammer, said discs having sharply inclined cam tracks formed thereon faced toward the hammer end faces and engageable with the cam follower balls thereof, the distance between the opposed cam discs being such that the hammer end face cam follower balls can contact only one cam disc cam track at a time, the rotation of the spindle and discs acting to rotate the contacted disc cam track against the cam follower balls of the hammer to throw the hammer longitudinally of the case and spindle against the other rotating cam disc, whose inclined track, in turn, rides against the cam follower balls of the hammer second face, to throw the hammer longitudinally of the case and spindle, back against the first cam.

2. In combination with a portable electric drill of the type having a housing and a motor driven drive shaft centered in a collar on said housing, an impact drill unit, comprising, a hollow case rigidly mounted at one end on the housing collar; three sets of aligned and freely rotatable bearing balls nested within the case wall and protruding into the interior of the case, said sets being spaced 120° apart; a spindle mounted on the end of the drive shaft, forming a continuation thereof, and extending through the case without touching it; a tool holding chuck mounted on the spindle end, beyond the case; a cylindrical hammer having an axial bore therethrough of greater diameter than the spindle, and longitudinal slots in the peripheral face thereof, spaced 120° apart, mounted in the case, over the spindle, with its peripheral slots engaged by the case bearing balls, whereby the so-supported hammer is free to reciprocate longitudinally of the case and spindle, but restrained against relative rotation thereto; the hammer also having cam follower balls embedded in its end faces; a first, or anvil disc, rigidly mounted on the spindle between the chuck and hammer, having an inclined cam track faced toward the hammer; a second, or throwing, disc rigidly mounted on the spindle on the far side of the hammer, having an inclined cam track faced toward the hammer; the distance between the opposed cam discs being such that the hammer end face cam follower balls can contact only one disc cam track at a time; the rotation of the spindle and discs acting to move the contacted disc cam track against the cam follower balls of the hammer to throw the hammer longitudinally of the case and spindle against the other rotating cam disc, whose inclined track, in turn rides against the cam follower balls of the hammer second face, to throw the hammer longitudinally of the case and spindle, back against the first cam, or anvil disc.

3. In combination with a portable electrical drill of the type having a housing and a motor driven drive shaft centered in a collar on said housing, an impact drill unit, comprising, a hollow case rigidly mounted at one end on the housing collar; three sets of aligned and freely rotatable bearing balls nested within the case wall and protruding into the interior of the case, said sets being spaced 120° apart; a spindle mounted on the end of the drive shaft, forming a continuation thereof, and extending through the case without touching it; a tool holding chuck mounted on the spindle end, beyond the case; a cylindrical hammer having an axial bore therethrough of greater diameter than the spindle, and longitudinal slots in the peripheral face thereof, spaced 120° apart, mounted in the case, over the spindle, with its peripheral

5

slots engaged by the case bearing balls, whereby the so-supported hammer is free to reciprocate longitudinally of the case and spindle, but restrained against relative rotation thereto; the hammer also having cam follower balls embedded in both its end faces, the embedded balls of one end face being radially displaced approximately 90° with reference to those of the other end face; a first, or anvil, disc mounted rigidly on the spindle between the chuck and hammer, having a gradually inclined cam track faced toward the hammer; a second, or throwing, disc rigidly mounted on the spindle on the far side of the hammer, having a steeply inclined cam track faced toward the hammer, the relative positions of the so opposed cam tracks being such that as the spindle rotates the high point of the throwing disc cam track is ahead of the low point of the anvil disc, or return, cam

6

track; the distance between the opposed cam disc tracks being such that the hammer end face cam follower balls can contact only one disc cam track at a time; the rotation of the spindle and discs acting to move the contacted disc track against the cam follower balls of the hammer to throw the hammer longitudinally of the spindle against the other rotating cam disc, whose inclined track, in turn, rides against the cam follower balls of the second hammer face, to throw the hammer longitudinally of the spindle, back against the first disc.

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