

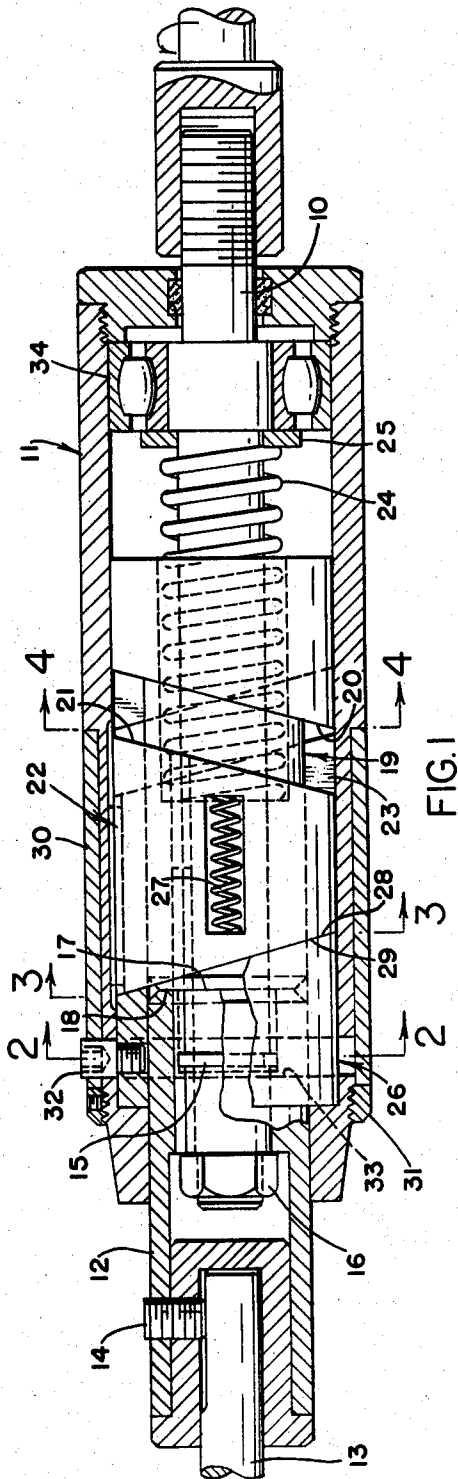
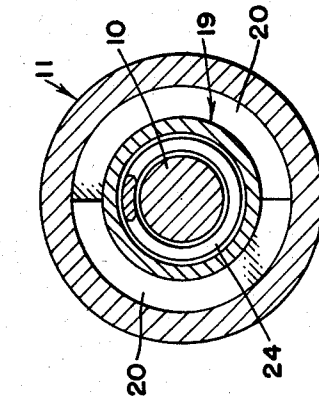
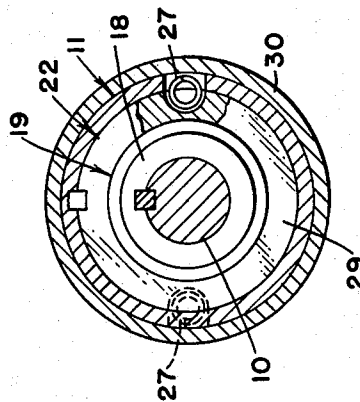
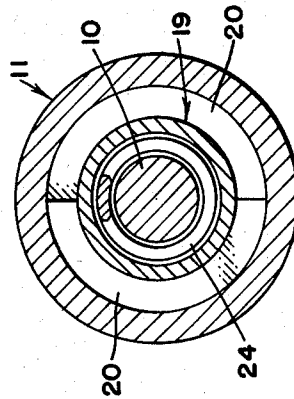
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ROTARY PERCUSSIVE POWER TOOL

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ROTARY PERCUSSIVE POWER TOOL

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This invention pertains to the art of rotary percussive power tools, and more particularly to a device for applying an axial percussive force to the working end of a rotating, cutting tool.

The invention is particularly applicable to a device adapted to be mounted between a portable electric drill and a rotating tungsten-carbide tipped drill, and will be described with particular reference thereto although it will be appreciated that the invention has broader applications, and for example, may be incorporated in the portable electric drill itself, or in fixed apparatus if desired.

In the art of drilling cement, masonry, or other non-metallic substances, it is known that substantially increased drilling speeds and more rapid cutting can be obtained if, while the drill is being rotated in contact with the work, an axial percussive force is periodically applied to the drill. Such percussive force drives the cutting edges of the drill axially into the cement, or the like, to greatly accelerate the drilling operation.

Various means have been proposed in the past to obtain this result, for example, a cam rotating with the drill and having a gradual axial rise, and an abrupt drop-off, together with a spring biased follower which is pushed back by the cam and allowed to drop abruptly to impart a hammering action on the cam and thus on the drill. However, the hammering action on the cam surfaces caused excessive wear on these surfaces with the result that the manufacture of a long-life tool was extremely difficult and expensive.

Furthermore, it has been impossible with previous known devices to vary the amount of percussive force applied to the tool or to eliminate the percussion entirely. The inability to achieve this often resulted in breakage of the brittle drill tips when initially starting into work, because of the huge force exerted over a small area of the drill tip.

The present invention contemplates a new and improved device for applying a percussive action to a rotating drill which overcomes the above-mentioned difficulties of the prior art, and others, and provides a device which is simple in construction, rugged in operation, easy to manipulate, and which is economical to construct.

In accordance with the present invention, a device of the type described is provided with a tool holder having an anvil surface, and a reciprocating hammer member having a hammer surface, the hammer member including a cam follower surface separate from the hammer surface. The cam follower surface of the hammer member is adapted to rotate and cooperates with a stationary cam member having an axial rise and an abrupt drop-off. Spring means biases the hammer member toward the anvil surface and supplies the hammering force when the cam follower surface reaches the point of abrupt drop-off of the cam.

Further in accordance with the invention, the parts are so arranged that the cam following surface of the hammer

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member is spaced from the cam surface of the cam member at the point of abrupt drop-off when the hammer surface engages the anvil surface of the tool holder.

Further in accordance with the invention, means are provided to adjust the cam member toward and away from the follower, to vary the length of stroke of the hammer member and consequently the percussive force applied to the working end of the tool. The cam member is adjustable between a first position in which the cam and follower surfaces just clear each other at the point of drop-off when the hammer and anvil surfaces are engaged, and a second position in which the cam and follower are maintained out of engagement during rotation of hammer member.

Further in accordance with the invention, the tool holder is mounted on a drive shaft of a rotary drill and is capable of a small degree of axial movement relative to the shaft so that transmission of percussive effects to portions of the device other than the tool holder and tool is minimized or eliminated.

The principal object of the invention is the provision of a new and improved device for applying a percussive action to a rotating drill which has improved operation, is simple to use, and enables the percussive action to be readily controlled.

Another object of the invention is the provision of a new and improved device of a general type described wherein the hammer or percussive action takes place on surfaces other than the cam and follower surfaces.

Still another object of the invention is the provision of a means for varying the percussive force applied to the tool.

A further object of the invention is the provision in such a device of a means for selectively discontinuing the percussive effects.

A still further object of the invention is to mount the tool holder of the device in a manner such that transmission of the percussive effects to parts of said device other than the tool holder and tool is minimized or eliminated.

The invention may take physical form in certain parts and arrangements of parts, a preferred embodiment of which will be described in detail in this specification, and illustrated in the accompanying drawings which form a part hereof, and wherein:

Figure 1 is a side cross-sectional view with portions partly in elevation of a device for applying a percussive action to a rotating drill illustrating a preferred embodiment of the invention;

Figure 2 is a cross-sectional view of Figure 1 taken approximately on the line 2—2 thereof;

Figure 3 is a cross-sectional view of Figure 1 taken approximately on the line 3—3 thereof; and,

Figure 4 is a cross-sectional view of Figure 1 taken approximately on the line 4—4 thereof.

Referring now to the drawings wherein the showings are for the purposes of illustrating a preferred embodiment of the invention only, and not for the purposes of limiting the same, the figures show a device for applying a percussive action or effect to a rotating drill comprised of a drive shaft 10 rotatable in a fixed member in the form of a housing 11 and rotatably driven on the right-hand end by suitable power means (not shown). A tool holder 12 is slidable on, and keyed to the opposite or left-hand end of the shaft 10. This tool holder 12 extends beyond the left-hand end of the housing 11 and has an opening to receive the shank end of a drill 13 which drill is held in the holder 12 by any suitable holding means such as the set screw 14.

Means are provided for applying end thrust from the shaft 10 to the tool holder 12 and for at least partially

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absorbing thrust from the tool holder to the shaft in the same direction. Such means may be of any suitable type, but as shown herein comprise a thrust collar mounted near the left end of the shaft 10 and seated against the bottom of a counterbore in the right end of the tool holder. As illustrated, the thrust collar consists of a pair of C-shaped pieces 15 which fit into a groove near the end of the shaft. A retaining nut 16 is threaded onto the extreme left-hand end of the shaft 10 to secure the tool holder 12 to the shaft 10. In order to permit a small degree of axial movement of the tool holder relative to the shaft, the threaded end of the shaft is shouldered so that the distance between the thrust collar and the retaining nut, when locked in position, is slightly greater than the distance between opposed shoulders in the tool holder cooperating with the thrust collar and nut 16.

An anvil surface 17 is provided at the right-hand end of the tool holder 12 to receive periodic blows from a hammer surface 18 on the left-hand of a hammer member 19. Any suitable means may be provided to periodically reciprocate the hammer member 19 to cause the hammer surface 18 to strike the anvil surface 17 of the tool holder and drive the drill 13 into the work. In the preferred embodiment shown, the hammer member has a follower surface 20 adapted to cooperate with a cam surface 21 on a stationary cam member 22 fixed against rotation relative to the housing 11. The hammer member 19 is keyed to and axially slidable on the shaft 10 and rotates relative to the cam member 22. The surface 21 of the cam member is formed as an axial rise followed by an abrupt drop-off 23. There are two such cooperating surfaces and drop-offs shown on each the cam member 22 and hammer member 19. Accordingly, as the hammer member 19 is rotated with the drive shaft 10, it is driven each time to the right to lift the hammer surface 18 from the anvil surface 17 for each half revolution of the shaft. A helical compression spring 24 biases the hammer member 19 in the direction toward the tool holder 12 and is adapted, when the point of abrupt drop-off immediately following the high point of the cam surface 21 is reached, to impart a sudden leftward movement to the hammer member to effect a percussive blow against the anvil surface 17 of the tool holder 12. The spring 24 seats between a washer 25 and the bottom of a counterbore in the hammer member 19.

Means are provided to adjustably move the cam member 22 axially relative to the hammer member 19 so that the effective portion of the cam surface 21 engaged by the follower surface 20 may be varied to limit the length of stroke of the hammer member. As shown, the cam member 22 is keyed to the housing 11 with an elongated keyway being provided in the housing to enable axial movement of the cam member. Adjustment of the cam member 22 is accomplished in a rightward direction by rotation of a normally fixed second cam member 26 and in the leftward direction by a pair of springs 27 urging the cam member 22 against the member 26, and the latter against a seat in the housing 11. The opposite end of the springs 27 seat between the housing 11 and cam member 22. The second cam member 26 has an axially inclined surface 28 mating with a corresponding surface 29 on the cam member 22. The member 26 is capable of 180° rotation relative to the housing 11, to move the cam member 22 from a leftward position shown in Figure 1 in which the surfaces 20 and 21 are maintained out of engagement during rotation of the hammer member 19, to a second rightward position in which these surfaces are closely spaced but separated when the hammer and anvil surfaces 18 and 17 are in engagement. The cam member 22 may be infinitely adjusted between these two positions to enable selection by the operator of the extent of percussive force

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applied to the anvil surface of the tool holder, by varying the length of stroke of the hammer member. In any position of adjustment, there will preferably always be a clearance between the follower surface 20 and cam surface 21 at the point of abrupt drop-off when the hammer surface 18 strikes the anvil surface 17. The entire force of the spring will therefore be absorbed between the surfaces 17 and 18 and not between the surfaces 20 and 21.

It is obvious that means other than the second cam member 26 may be provided to shift the cam member 22 axially. The cam member 26 was selected for this purpose because it can be easily manufactured from the same stock as the cam member 22. They are made from a sleeve which serves not only the functions aforementioned, but also journals the tool holder 12, hammer member 19, and thereby, the left end of the shaft 10.

Any means may be provided to rotate the second cam member 26. Preferably this means is in the form of a sleeve 30 rotatable on the exterior of the housing 11 between a shoulder in the housing and a retaining nut 31. A set screw 32 is threaded radially into the member 26 with its head extending outwardly through the sleeve 30. A circumferential slot 33 is provided about 180° of the housing 11 and also receives the head of the screw 32. The ends of the slot serve as limits of rotation for the second cam member 26.

The adjustable stroke of the hammer member is provided for the following purpose. The tips of tungsten carbide drills are easily broken when great impact is provided over a relatively small area of the tip. Because of this, the percussive action is disadvantageous when first starting to drill into a surface. Consequently, it has been necessary in the past to compensate for the difference between the highest permissible starting force limited by the point at which a drill would break, and the much higher force desirable once the drill tip was completely below the surface of the work. This was done by selecting a spring having a force which was sufficiently low to prevent breaking of the drill tip when starting to drill, but which was also sufficiently high to give a fairly effective percussive action once drilling was under way. I have found that by eliminating the percussive blows initially and then increasing the force steadily to a much higher force, I not only prevent breaking of the drill tip, but am able to get much higher percussion than previously, once the drill tip is into and below the surface. The force of the spring 24 need no longer be limited by the breakage point of the drill tip when starting. It is now limited only by the maximum permissible percussive force at which a drill tip will break when the full area of the cutting edge is in contact with the subject being drilled. Therefore, I can get much higher impact force applied to the drill tip, and consequently much more rapid and efficient drilling.

In the preferred manner of operation of the device, when the operator is ready to commence drilling, he will grasp the sleeve and rotate it to that end of its travel in the slot which causes movement of the cam member to its position shown in Figure 1 to prevent reciprocation of the hammer member 19. As the tool tip gradually enters into the work, he will rotate the sleeve as required and thereby adjust the cam member 22 toward the follower surface 20. This will steadily increase the length of stroke and the percussive force of the hammer member 19. Once the tip of the tool is fully into the work, he may rotate the sleeve 30 to the other limit permitted by the slot 33 to increase the length of stroke to its maximum. During the entire operation, the full impact of the hammer member 19 will be absorbed by the anvil surface 17 of the tool holder 12 upon being struck by the hammer surface 18, since the surfaces 20 and 21 cannot engage when the spring 24 rapidly moves the hammer member 19 leftwardly at the point of abrupt drop-off.

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It will further be appreciated that in normal operation of the device, the drill will be forced into the work by the operator. Therefore, the drive shaft 10 will have a leftward force exerted thereon. A thrust bearing 34 mounted in the right-hand end of the housing 11 journals the shaft 11 to provide a like leftward force on the housing 11. Under this condition, the thrust collar formed by the pieces 15 will engage its corresponding shoulder in the tool holder 12 with a small amount of clearance existing between the nut 16 and its corresponding shoulder in the tool holder. Now, after the cam member 22 has lifted the hammer member beyond the point of abrupt drop-off and the spring has caused the hammer surface 18 to strike the anvil surface 17, the impact will move the tool holder leftwardly relative to the shaft, causing a slight momentary separation between the thrust collar and its cooperating shoulder in the tool holder. The movement is permitted by the clearance between the nut 16 and its cooperating shoulder. The percussive blow is thereby imparted primarily or solely to the tool holder 12 and drill 13. Transmission of the blow to other parts of the device will be minimized or possibly eliminated. While the hammer member 19 continues to rotate with the drill and again start its rightward movement, the hammer and anvil surfaces will again be separated and the force of the operator in bearing down on the drill will again cause the thrust collar to engage the shoulder in the tool holder.

The invention has been described with reference to a preferred embodiment. It will be appreciated that modifications and alterations will occur to others upon a reading and understanding of this specification, which modifications and alterations will differ radically in appearance from the preferred embodiment herein described. It is my intention to include all such modifications and alterations insofar as they come within the scope of the appended claims.

Having thus described my invention, I claim:

1. A device for applying axial percussive effects to a rotating tool comprising in combination: a member fixed against rotation, a drive shaft rotatable and axially immovable relative to said fixed member, a tool holder rotatable with said shaft and receiving said tool, said holder having an anvil surface facing in the direction opposite to the working end of said tool, a hammer member axially slidable relative to said shaft and rotatable therewith, said hammer member having a hammer surface cooperating with the anvil surface of the tool holder, and means for imparting an intermittent reciprocation to said hammer member, said last-named means including a fixed cam having an axial rise and an abrupt drop-off, a follower on said hammer member and cooperating with said cam, spring means biasing said follower toward said cam and said hammer surface toward and into pressure engagement with the anvil surface, said cam and follower members having a clearance at the point of abrupt drop-off when the hammer and anvil surfaces are in engagement.

2. A device for applying axial percussive effects to a rotating tool comprising in combination a member fixed against rotation, a drive shaft rotatable and axially immovable relative to said fixed member, a tool holder rotatable with said shaft and receiving said tool, said holder having an anvil surface facing in the direction opposite to the working end of said tool, a hammer member axially slidable relative to said shaft and rotatable therewith, said hammer member having a hammer surface cooperating with the anvil surface of the tool holder, and means for imparting an intermittent reciprocation to said hammer, said last-named means including a fixed cam having an axial rise and an abrupt drop-off, a follower on said hammer member and cooperating with said cam, spring means biasing said follower toward said cam and said hammer surface toward and into pressure engagement with the anvil surface, and means for adjusting the cam

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axially toward or away from the follower to increase or decrease the effective portion of the axial rise of the cam engaged by the follower, to thereby vary the length of stroke of said hammer member and consequently the percussive force applied to the tool.

3. A device according to claim 2 in which the adjusting means is operable to move said cam between a first position in which the cam and follower just clear each other at the point of abrupt drop-off when the hammer and anvil surfaces are engaged, and a second position in which the cam and follower are maintained out of engagement during rotation of the hammer member.

4. A device for applying axial percussive effects to a rotating tool comprising in combination a housing fixed against rotation, a rotatable drive shaft extending into said housing from one end thereof and being axially immovable relative thereto, a tool holder slidable on and rotatable with said shaft, said tool holder having a tool receiving portion facing outwardly of the other end of the housing and an anvil surface facing inwardly of the housing, a reciprocable hammer member axially slidable on said shaft and rotatable therewith, said hammer member having a hammer surface cooperating with the anvil surface of the tool holder, a cam member coaxial with said shaft and having an axial rise and an abrupt drop-off, said hammer member having a follower portion independent of said hammer surface which follower portion cooperates with said cam member to intermittently drive the hammer member in a direction away from the tool holder during rotation of the drive shaft, and spring means biasing said hammer member in the direction toward said tool whereby a power stroke is imparted to the anvil surface of the tool holder by the hammer surface of the hammer member each time the follower portion of the latter drops off the rise of the cam, and said cam member and follower portion of the hammer member have a clearance at the point of abrupt drop-off when the hammer and anvil surfaces are in engagement.

5. A device for applying axial percussive effects to a rotating tool comprising in combination: a housing fixed against rotation, a rotatable drive shaft extending into said housing from one end thereof and being axially immovable relative thereto, a tool holder slidable on and rotatable with said shaft, said tool holder having a tool receiving portion facing outwardly of the other end of the housing and an anvil surface facing inwardly of the housing, a reciprocable hammer member axially slidable on said shaft and rotatable therewith, said hammer member having a hammer surface cooperating with the anvil surface of the tool holder, a cam member coaxial with said shaft and having an axial rise and an abrupt drop-off, said hammer member having a follower portion independent of said hammer surface which follower portion cooperates with said cam member to intermittently drive the hammer member in a direction away from the tool holder during rotation of the drive shaft, and spring means biasing said hammer member in the direction toward said tool whereby a power stroke is imparted to the anvil surface of the tool holder by the hammer surface of the hammer member each time the follower portion of the latter drops off the rise of the cam, and said tool holder is mounted on the shaft between opposed shoulders thereof and is capable of slight axial movement relative thereto.

6. A device for applying axial percussive effects to a rotating tool comprising in combination: a housing fixed against rotation, a rotatable drive shaft extending into said housing from one end thereof and being axially immovable relative thereto, a tool holder slidable on and rotatable with said shaft, said tool holder having a tool receiving portion facing outwardly of the other end of the housing and an anvil surface facing inwardly of the housing, a reciprocable hammer member axially slidable on said shaft and rotatable therewith, said hammer member having a hammer surface cooperating with the anvil

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surface of the tool holder, a cam member coaxial with said shaft and having an axial rise and an abrupt drop-off, said hammer member having a follower portion independent of said hammer surface which follower portion cooperates with said cam member to intermittently drive the hammer member in a direction away from the tool holder during rotation of the drive shaft, and spring means biasing said hammer member in the direction toward said tool holder by the hammer surface of the hammer member each time the follower portion of the latter drops off the rise of the cam, and means for adjusting the cam member axially to increase or decrease the effective portion of the axial rise of the cam engaged by the follower to thereby vary the length of stroke of said hammer member and consequently the percussive force applied to the tool.

7. A device according to claim 6 in which the adjusting means are operable to move said cam between a first position in which the cam and follower just clear each other at the point of abrupt drop-off when the hammer and anvil surfaces are engaged, and a second position in which the cam and follower are maintained out of engagement during rotation of the hammer member.

8. A device according to claim 6 in which said housing is tubular, and in which said adjusting means comprises a rotatable sleeve mounted on said housing and operatively connected to said cam member.

9. A device according to claim 8 in which said cam member is provided with an inclined surface on its end remote from the follower, and in which a second cam member fixed to said sleeve is rotatable therewith and cooperates with the inclined surface to effectuate the adjustment of the first cam member.

10. A device according to claim 9 in which spring means intermediate said housing and the first cam member urges said cam members in a direction away from the follower portion of the hammer member.

11. A device for applying axial percussive effects to a rotating tool comprising in combination a member fixed against rotation, a drive shaft rotatable in and axially immovable relative to said fixed member, a tool holder rotatable with said shaft and receiving said tool, said

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holder having an anvil surface facing in the direction opposite to the working end of the tool, a reciprocable hammer member having a hammer surface engageable at one end of its reciprocating stroke with said anvil surface to impart a blow to said anvil surface and thereby to said tool, means for reciprocating said hammer member, and manually operable means cooperatively associated with said reciprocating means for varying the length of stroke of the hammer member, said reciprocating means comprising a cam member fixed against rotation relative to the fixed member, said cam member having an axial rise and an abrupt drop-off, a follower on said hammer member and rotatable with said shaft, and spring means urging the hammer surface toward said anvil surface.

12. A device for applying axial percussive effects to a rotating tool comprising in combination a member fixed against rotation, a drive shaft rotatable in and axially immovable relative to said fixed member, means for rotating said shaft, a tool holder rotatable with said shaft and receiving said tool, said holder having an anvil surface facing in the direction opposite to the working end of the tool, a reciprocable hammer member having a hammer surface engageable at one end of its stroke with said anvil surface and rotatable with said shaft, means for reciprocating said hammer member as it rotates, manually operable means for disabling said reciprocating means, said hammer member reciprocating means comprising cooperating cam and follower members, and said disabling means comprising means for adjusting the position of said cam member to alter the effective portion of the cam engaged by the follower, whereby the length of stroke of the hammer member and consequently the percussive force applied to the working end of the tool may be varied.

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