Feb. 5, 1957 M. LOVEQUIST 2,780,106

ROTARY IMPACT DRILL

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Fig. 1

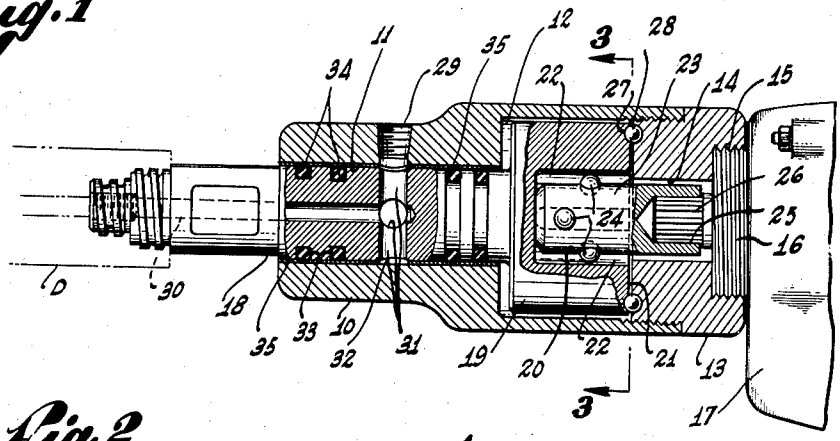


Fig. 2

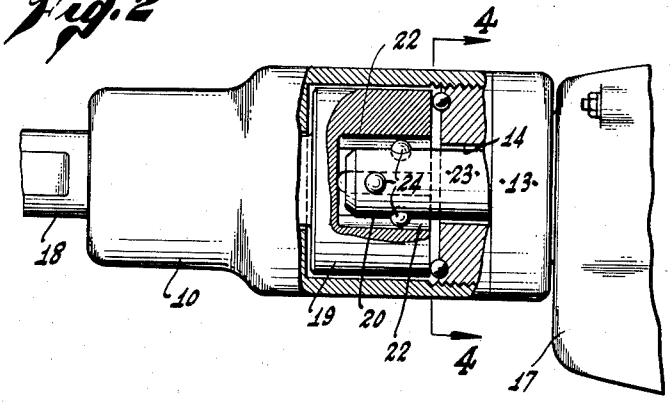


Fig. 3

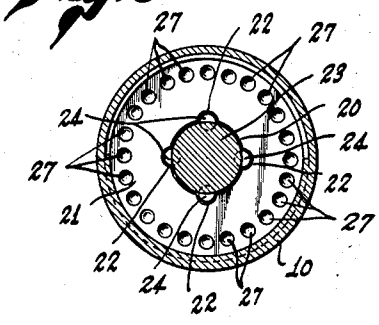
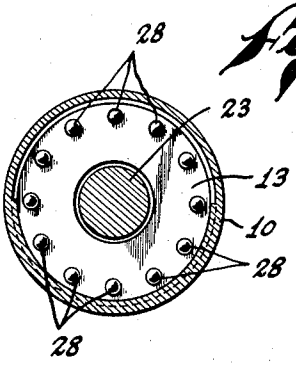


Fig. 4



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ROTARY IMPACT DRILL

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8 Claims. (Cl. 74—22)

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 or other member.

In many operations, and most notably in masonry drilling, it is necessary that a member be simultaneously rotated about a given axis and subjected to impacts along its axis of rotation. Thus, the drill bits employed in drilling concrete, brick, or other like materials are, during drilling operations, slowly rotated or oscillated about their longitudinal axes and impacted in the direction of such axes.

This invention has as its general object the provision of an improved rotary hammer device for use with such masonry drill bits or other rotary, axial impact tools.

Another object of the invention is the provision of a rotary hammer mechanism for rotating a drill bit or the like and simultaneously applying axial impacts thereto, which device is simple in construction and relatively inexpensive to manufacture.

Still a further object of the invention is the provision of a rotary hammer attachment for use with standard electric drills.

These and other objects of the invention are attained, generally, by providing a housing adapted to be secured to a motor driven device such as a portable electric drill. Mounted within the housing for rotational as well as limited axial movement is a shaft having one end extending exteriorly of the housing and provided with means for connection to a drill bit or the like. The opposite end of the shaft is enlarged and has formed on its end face a plurality of cam surfaces engageable, upon pressure of the drill bit against the work, with cooperating cam elements carried by the housing. Slidably and non-rotatably engaged in this latter end of the shaft is a socket element for connection to the rotary shaft of an electric drill or the like.

The arrangement is such that when the shaft is driven in rotation, the cam members will override each other to cause a series of rapid axial impacts to be imparted to the shaft.

A better understanding of the invention may be had by a reading of the following detailed description wherein reference is made to the annexed drawings in which:

Figure 1 is a side elevation, partially in section, of the rotary hammer device of this invention with the cam members shown in one position of engagement;

Figure 2 is a side elevation, partially in section, of the present rotary hammer device showing the cam members thereof in another position of engagement;

Figure 3 is a transverse sectional view taken substantially along line 3—3 of Figure 1 and showing the camming surfaces on the end face of the shaft; and

Figure 4 is a transverse sectional view taken substantially along line 4—4 of Figure 2 and showing the cam elements carried by the housing.

The present rotary hammer, as shown in Figures 1 and 2, comprises an elongated, generally cylindrical housing 10 having a passageway 11 extending into one end thereof and communicating at its inner end with an enlarged, internally threaded bore 12 opening through the other end of the housing. A plug 13 having an axial bore 14 extending completely through it is threaded into the open end of bore 12. The outer end of bore 14 is counter-bored and internally threaded, as shown at 15 for receiving an externally threaded extension 16 formed on an electric drill 17, or the like.

Slidably and rotatably mounted in the passageway 11 of housing 10 is a driven shaft 18 having at one end an enlarged head portion 19 slidably and rotatably disposed in the enlarged bore 12 of the housing. One end 21 of the head 19 is adjacent the inner end of the plug 13, and the opposite end of the shaft 18, projecting beyond the housing 10, may be threaded, as shown, or provided with other means for attaching thereto a drill bit D, or the like.

The enlarged head 19 has an axial socket 20 provided in its end 21, the wall of which socket is, as shown more clearly in Figure 3, formed with axially extending, circumferentially spaced grooves or splines 22. Slidably positioned in the socket 20 is a driving shaft 23 having keys 24 engaging in the splines 22 to provide a driving connection between shafts 18 and 23 while permitting relative axial movement thereof. Keys 23, which may be balls imbedded in shaft 23 as shown, are preferably axially offset in the manner illustrated to prevent relative tilting of the shafts.

A splined socket 25 is formed in the outer end of shaft 23 for drivably receiving the power output shaft 26 of drill 17. It is generally desirable that drill 17 include speed reduction gearing (not shown) so that the shaft 26 will turn at a relatively low speed.

The axial impacts imparted to shaft 18 during its rotation are provided by a pair of overriding cam members on the shaft head 19 and the plug member 13. Thus in the form shown, the shaft head 19 has a plurality of angularly spaced recesses or depressions 27 (Figure 3) formed in its face 21 and arranged in a circle concentric with the shaft 18. To cooperate with these recesses or depressions 27, the plug member 13 is provided with a plurality of projections 28 forming cam elements adapted to have the recesses or camming surfaces 27 ride thereover during rotation of shaft 18. These cam elements may be in the form of balls, as shown, imbedded in the inner end face of plug 13, preferably to a depth slightly greater than the radius of such balls. The balls 28 are, as shown more clearly in Figure 4, arranged in a circle which is concentric with the shaft 18 and whose diameter is equal to that of the circle of the recesses or depressions 27. The number of balls 28 may be less than the number of recesses 27, but the balls should be equally spaced about the axis of shaft 18, as should the recesses, and number of recesses should be a whole number multiple of the number of balls so that all of the balls will simultaneously fit into corresponding recesses.

Thus, by pressing the drill bit D against the work while the electric drill 17 is rotating the shaft 18, the camming surfaces 27 are forced into engagement with the cam elements 28, and the overriding of the camming surfaces and the cam elements will cause a series of axial impacts to be imparted to the shaft 18 and hence to the drill bit. It will be appreciated that the enlarged head 19 of shaft 18 has sufficient axial clearance in the bore 12 to accommodate the resultant reciprocal movement of the head.

In some instance it may be desirable to supply fluid to the cutting end (not shown) of the drill bit D. For this purpose, the housing 10 may have a radial port 29 communicating with the passageway 11, which port is adapted for connection to a source of a fluid (not shown). In such cases, the shaft 18 will be formed with an axial pas-

sage 30 communicating at one end with a bore extending through the drill bit D toward its cutting end as indicated in Figure 1. The other end of passage 30 is connected with radial passages 31 that terminate in a peripheral groove 32 aligned with port 29 so that fluid may be pumped through port 29, through shaft 18, and through the drill bit D to the cutting end of the latter. Where such a fluid feed arrangement is employed, shaft 18 should have a sealing means such as a plurality of annular grooves 33 formed therein on opposite sides of groove 32 for receiving O-rings 34 or other suitable fluid sealing devices to prevent the escape of the fluid between the shaft 18 and the walls of the passageway 11. Bushings 35 are provided at each end of the passageway 11 to support the shaft 18, thus preventing its binding or "freezing" on the housing.

It will be apparent, of course, that numerous modifications in the design and arrangement of parts of the present rotary hammer are possible in the light of the foregoing teachings. Accordingly, the invention is not intended to be limited to the precise embodiment chosen for illustrative purposes but only by the spirit and scope of the following claims.

What is claimed is:

1. A rotary hammer device comprising: a housing; a shaft mounted in the housing for rotary and limited axial movement; means on said shaft and within said housing for connection to a rotary driving element; and cooperating cam means on said shaft and housing for imparting impacts to the shaft along its axis of rotation when the shaft is rotated in the housing, said cooperating cam means comprising a plurality of circumferentially arranged camming portions on an end face of said shaft and rotating therewith, and a plurality of cooperating circumferentially arranged camming portions on the housing and held stationary thereby.

2. A rotary hammer device comprising: a housing having a bore extending therethrough; a shaft mounted in said bore for rotary and limited axial movement; means on said shaft for connection to a rotary driving member held against axial movement; means forming an annular shoulder on said housing at one end of the bore, the adjacent end face of the shaft having a plurality of circumferentially arranged depressions therein defining camming surfaces; and a plurality of circumferentially arranged projections defining stationary cam elements on said shoulder, said camming surfaces being adapted to rotate and ride over said stationary cam elements when the shaft is rotated in the housing to impart axial impacts to the shaft.

3. A rotary hammer device comprising: a housing having a bore extending therethrough; means defining an annular shoulder connected to said housing and held thereby against rotation at one end of the bore; a shaft mounted in said bore for rotary and limited axial movement and having an end face opposing said shoulder, there

being a plurality of circumferentially arranged spherical depressions provided in said end face rotatable with said shaft; a plurality of circumferentially arranged spherical projections on said shoulder, held against rotation and axial movement and adapted to ride over said depressions when the shaft is rotated in the housing whereby to impart axial impacts to said shaft; and means for connecting said shaft to a rotary driving member held against axial movement.

4. A rotary hammer device according to claim 3 wherein said spherical projections comprise balls partially imbedded in said shoulder.

5. A rotary hammer device comprising: an elongated housing formed with a bore having a reduced diameter portion opening through one end of the housing and an enlarged diameter portion opening through the other end of the housing; an annular plug fixed in the open end of the latter of said portions and defining an annular inwardly facing shoulder held against rotary and axial movement with respect to said housing; a shaft mounted in said bore for rotary and limited axial movement and including an enlarged head portion disposed in said enlarged bore portion and moving with said shaft, the end face of said head portion opposing said shoulder and having formed therein a plurality of circumferentially arranged spherical depressions; a plurality of circumferentially arranged balls partially imbedded in said shoulder, adapted to ride over said depressions when the shaft is rotated in the housing for imparting axial impacts to the shaft; a member extending into the opening in said plug and slidably and non-rotatably coupled to said shaft; and means on said member for connection to a rotary driving element.

6. A rotary hammer device according to claim 5 wherein the coupling of said member to the shaft comprises an axial splined socket in said end face of the shaft for slidably receiving said member, the latter having keys engaged in said splines.

7. A rotary hammer device according to claim 6 wherein said keys comprise circumferentially spaced balls partially imbedded in said members, said balls being axially offset to prevent relative tilting of the shaft and member.

8. A rotary hammer device according to claim 5 and including means for securing said housing to the housing of a portable electric drill, said means on said member being adapted to drivingly engage the rotary driven part of the drill.

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