The rotary hammer power tool includes a tappet subjected to rotation and to axial hammering blows simultaneously. The tappet has a first set of clutch teeth and a centrally disposed hammering formation. A tool bit driver is rotatably mounted coaxially with the tappet and has a hexagonal bore adapted to receive a correspondingly shaped shank of a tool element. The driver has a second set of clutch teeth engageable with the first set of clutch teeth whereby to permit the tappet to transfer rotation to the driver. Selection means are engaged with the driver for reciprocating the same axially thereby to engage and disengage the clutch teeth for selectively imparting rotation to the driver and to the tool element received therein.

5 Claims, 4 Drawing Figures
ROTARY DISCONNECT FOR A ROTARY HAMMER TOOL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of the invention relates to portable power tools. More particularly, the field of the present invention relates to so-called rotary hammer power tools, i.e., power tools which have the capability of imparting simultaneous rotation and axial hammering blows to a tool element for working on concrete, for example.

2. The Prior Art

Rotary hammer power tools of the type referred to are well known in the prior art. These tools are usually powered by either an electric or pneumatic motor and include a rotary output or drive member having a hexagonal bore for receiving the correspondingly shaped shank of a tool element or adapter thereby to impart rotation to the latter. These tools include a hammering mechanism, quite often in the form of a striker which is pneumatically reciprocated and arranged to strike the distal end of the shank of the tool element or adapter thereby to impart axial hammering blows to the latter simultaneously with the aforementioned rotation.

Representative prior art tools are shown in Naslund et al. U.S. Pat. No. 3,114,423, McCloud U.S. Pat. No. 3,114,421 and Bassett et al. U.S. Pat. No. 3,270,821, all assigned to the assignee of the present invention.

In the use of power tools of the type under consideration, it is often required or at least desirable at certain times to impart a hammering action only to the tool element or adapter or to impart rotation only to the tool element. When using the power tools shown in the aforementioned patents, these different modes of operation are brought about by removing the element or adapter and replacing the same with a different element or adapter. In other words, these power tools are provided with plural different tool elements each specially configured to cooperate with the hammering and rotary components of the power tool for bringing about the desired mode of operation.

In some uses of these rotary hammer power tools, it is too time consuming for the operator to stop the tool, remove the tool element and insert a different tool element to achieve a different mode of operation. For example, when installing certain anchors in concrete structures, it is necessary first to hammer the anchor thereby to penetrate the concrete a short distance, and thereafter to impart simultaneous hammering and rotation to the anchor. Then, rotation only must be imparted to the anchor for removing the same in order to evacuate dust from the bore formed in the concrete. Finally, the anchor must be hammered in place without rotation. This operation could not be achieved economically and expeditiously if the operator were required to change the tool element each time to bring about the various modes of operation just described.

SUMMARY AND OBJECTS OF THE INVENTION

A primary object of the present invention is the provision of a rotary hammer power tool having means for quickly and easily converting the mode of operation from simultaneous hammering and rotation to hammering only and vice versa.

Another object of the present invention is the provision of a power tool of the type described including a tappet which is subjected simultaneously to rotation and to axial hammering blows and which has a first set of clutch teeth, and a tool bit driver mounted for rotation coaxially with the tappet and having a hexagonal bore for receiving the hexagonal shank of a tool element, which driver has a second set of clutch teeth for engagement with the first set of clutch teeth, and selection means for reciprocating the driver thereby to engage and disengage the first and second sets of clutch teeth for selectively imparting rotation to the driver and a tool element received therein.

Still another object of the present invention is the provision of a power tool according to the foregoing object, wherein such selection means is of simple and inexpensive construction and may be manually operated.

These and other objects and advantages of the present invention will become apparent from the following specification disclosing a preferred embodiment shown in the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a power tool embodying the present invention;
FIG. 2 is an enlarged fragmentary vertical section taken through the power tool of FIG. 1 and showing the same configured for imparting simultaneous rotation and hammering movements to a tool element;
FIG. 3 is a section similar to FIG. 2, but showing the tool configured for imparting a hammering action only to the tool element; and
FIG. 4 is an enlarged fragmentary vertical section of the power tool of FIG. 1.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1, a rotary hammer power tool is generally designated 10 and is seen to include a main housing 11 and an auxiliary housing 12. The tool includes a pistol grip type handle 13 and an auxiliary handle 14. It will be understood that the power tool 10 may include any suitable mechanism for imparting simultaneous rotation and hammering to an output member, reference being had to the aforementioned patents assigned to the assignee of the present invention. By way of example only and not by way of limitation, the present invention will be shown and described in association with the rotary hammer mechanism disclosed and claimed in the aforementioned Bassett et al. patent.

Referring momentarily to FIG. 4, the Bassett et al. mechanism includes an electric motor 16 having an output shaft 17 engaged with a gear train (not shown), which gear train engages teeth 18 on a barrel 19, the latter being mounted for rotation in the housing 11 by a ball bearing assembly 20. The barrel 19 mounts a nose member 22 for rotation therewith, which nose member has a hexagonally shaped bore 23. The barrel 19 also includes a sleeve 24 which receives a cam element 25. This cam element includes a central hexagonal bore 26 as well as a series of cams 27. The Bassett et al. structure further includes a hammer integral with a cam element 28 having a series of cams 29 for engagement with the cams 27. The cam element 28 is mounted for reciprocal movement only and is part of the hammer; in this respect, the element 28 includes a centrally disposed hammering formation 30.

According to the Bassett et al. mechanism, the barrel 19 and consequently the member 22 rotate whenever
the tool is in operation. Such rotation of the nose member 22 will cause corresponding rotation to a hexagonally shaped tool shank received therein. If such shank has a length for being received within the bore 26 of the cam element 25, the latter will be rotated thereby to bring about operation of the hammer due to the interengagement of the cams 27, 29. For further particulars of this rotary hammer mechanism, reference should be had to the Basset et al. patent.

The present invention will be seen to include a tappet, generally designated 32, and rotatably received in the auxiliary housing 12. The tappet includes a first cylindrical portion 33 rotatably and slidably received within a bore portion 34 of the housing 12. The tappet further includes a reduced-in-diameter cylindrical portion 35 joining with the cylindrical portion 33 to form an annular shoulder 36. The tappet portion 35 is rotatably received within a bore portion 37 of the housing 12, which bore portion joins with the portion 34 to define an annular shoulder 38. It will be understood that forward or outward movement of the tappet 32 is limited by abutting engagement of the shoulder 36 with the shoulder 38. Rearward or inward movement of the tappet is limited by abutting engagement of the portion 33 with the nose member 22. Of course, the tappet 32 is mounted for rotation within the bore portions 34, 37.

At this time it should be mentioned that the bore portion 34 includes an annular recess 40 in which an O-ring 41 is received. As will be explained hereinbelow, this O-ring frictionally engages the portion 33 of the tappet to prevent flutter thereof at certain times during the operation of the power tool.

The tappet 32 includes a hexagonally shaped shank 44 which is received within the bores 23, 26. Thus, rotation is imparted to the tappet 32 by the nose member 22. Since the shank 44 extends into the bore 26, this shank causes rotation of the cam element 25 to bring about operation of the hammering mechanism. When the tappet 32 is in its innermost position, the distal end of the shank 44 will be struck or hammered by the formation 30 on the cam element 28.

The tappet 32 includes an annular or circumferential series of clutch teeth 46, each tooth being defined by an inclined surface 47 and a surface 48, the latter being contained in a plane radially disposed with respect to the axis of rotation of the tappet. The tappet 32 also includes a hammering surface 49 centrally disposed with respect to the clutch teeth 46.

A tool bit driver, generally designated 52, is cylindrical in form and is rotatably mounted within the bore portion 37 of the auxiliary housing 12. The tool bit driver includes a through central opening defined by a hexagonal bore 53 and an annular bore 54. The tool bit driver includes an exterior annular recess 56. Finally, the member 52 includes a circumferential series of clutch teeth 57. These clutch teeth are identical as in the opposite hand relation with the clutch teeth 46 on the tappet 32. To this end, each of the teeth 57 includes an inclined surface 58 and a surface 59, the latter being contained in a plane radially disposed with respect to the axis of rotation of the tool bit driver 52.

The auxiliary housing 12 includes an annular recess receiving a disk-like member 62. This member is rotatably retained in such recess by a snap washer 63. A shift lever or operating member 64 is secured to the disk-like member 62, as by means of a threaded fas-

tener 65. It will be understood that the operator of the tool grasps the shift lever 64 for imparting rotation to the disk-like member 62.

The member 62 mounts a pin 67 eccentrically disposed with respect to its center of rotation. The pin 67 mounts a roller 68 which is received within the annular recess 56 of the tool bit driver 52. It will be apparent that partial rotation of the disk-like member 62 in response to actuation of the shift lever will cause axial re-

ciprocal movement of the tool bit driver 52 thereby to bring about engagement and disengagement of the clutch teeth 46, 57. Preferably, detent means (not shown) are provided to establish the two positions of the shift lever thereby in turn establishing the forward (disengaged) and rearward (engaged) axial positions of the tool bit driver 52.

Referring particularly to FIG. 4, it will be seen that the auxiliary housing 12 includes a bore portion 70 communicating with the bore portion 37. An annular dust seal 71 is mounted at the innermost end of the bore portion 70. The bore 70 communicates with a transversely disposed bore 72, the latter rotatably receiving an element 73 of a tool retainer of the type well known to those skilled in the art.

A tool element or adapter, generally designated 75, is fragmentarily shown in FIGS. 2 and 3 and will be seen to include a cylindrical portion 76 joining with a reduced-in-diameter cylindrical portion 77, the latter cooperating with the retainer element 73 to hold the tool element 75 in place although permitting both rotation and limited axial movement thereof. The cylindrical portion 77 joins with another cylindrical portion 78, the latter in turn joining with a hexagonally shaped shank portion 79. This shank portion is received within the hexagonal bore 53 of the tool bit driver 52; accordingly, rotation of the driver will impart corresponding rotation to the tool element 75. When the tool element 75 is in its innermost position, the distal end of the shank portion 79 is arranged to be engaged or abutted by the hammering formation 49 on the tappet 32.

The operation of the power tool according to the present invention will be explained by first referring to FIG. 2 which shows the shift lever 64 positioned for bringing about engagement of the clutch teeth 46, 57. Since the clutch teeth are engaged, the tappet 32 will transfer rotation to the tool bit driver 52 thereby in turn imparting rotation to the tool element 75. The tool element will be subjected simultaneously to hammering blows due to the engagement between the hammering formation 49 and the distal end of the tool element shank 79.

If it is desired to impart a hammering action only to the tool element 75, the shift lever 64 is actuated to slide the tool bit driver 52 forwardly thereby disengaging the clutch teeth 46, 57. Accordingly, the tool bit driver 52 will no longer be rotated and consequently rotation will not be imparted to the tool element 75. However, hammering blows will still be imparted to the tool element due to the engagement of the hammering formation 49 with the distal end of the shank 79. It will be apparent that the shift lever 64 may be actuated while the tool is in operation to engage the clutch teeth as well as to disengage said clutch teeth.

Accordingly, it will be seen that the present invention provides a unique, easy-to-operate means for rapidly converting from simultaneous hammering and rotation to hammering only and vice versa. It should be noted
that the engagement between the annular shoulders 36, 38 limits the forwardmost position of the tappet 32 thereby to prevent the latter from causing damage to any parts of the selection means, particularly the pin 67. It also should be noted that when a tool element is not received in the bore 70 or is allowed to occupy its forwardmost or outermost position as determined by the retainer element 73, the tappet 32 will be allowed to move forwardly or outwardly until it is stopped by engagement of the shoulders 36, 38. In this position of the tappet 32, the distal end of the shank 44 is beyond the range of movement of the hammering formation 30 on the cam 28. The O-ring 41 fractionally engages the tappet and acts to minimize fluttering movement of the tappet.

It will be apparent that the hammering action will be provided only when the tappet 32 is forced inwardly to bring the distal end of the shank 44 within the range of reciprocal hammering movement of the formation 30. The operator causes the shank 44 to be brought into hammering engagement by the formation 30 by urging the power tool against the work. This result obtains since the distal end of the shank portion 79 of the tool element abuts the hammering formation 49 on the tappet 32 thereby to force the latter inwardly so as to be hammered by the formation 30. Consequently, the operator controls the hammering action and may bring about a cessation of hammering simply by withdrawing the power tool a short distance from the work which will allow the distal end of the shank 44 to move beyond the range of reciprocal hammering action of the formation 30. Thus, it is apparent that in the use of the power tool according to the present invention, three different modes of operation, i.e., simultaneous hammering and rotation, rotation only and hammering only, may be quickly and easily achieved without changing the tool element or adapter.

The engagement of the sets of clutch teeth 46, 57 serves to transfer rotation only from the tappet 32 to the tool bit driver 52. This result is obtained since the faces 48, 59 of the respective sets of clutch teeth which engage each other are contained in planes radially disposed with respect to the axis of rotation of the tappet and tool bit driver. As noted in FIG. 2, when such faces of the clutch teeth are engaged, the inclined faces or surfaces 47, 58 of the clutch teeth are in spaced relation; these inclined surfaces of the clutch teeth are never brought into engagement with each other. Thus, hammering blows are not transmitted to the tool bit driver 52 or any parts of the selection means constituted primarily by the shift lever 64.

I claim:

1. In a rotary hammer power tool of the type having an output member in the form of a tappet which is adapted to be subjected to rotation and to axial hammering blows simultaneously, the improvement comprising:
   a. said tappet having a first set of clutch teeth and oppositely extending, centrally disposed, first and second hammering formations;
   b. a rotary tool bit driver and wall means mounting the same for rotation coaxially with said tappet, said wall means also permitting axial reciprocal movement of said driver, which driver has a centrally disposed, axial, through bore and a second set of clutch teeth adapted for engagement with said first set of clutch teeth thereby to permit said tappet to transfer rotation to said driver;
   c. a tool element having a shank received in said bore of said driver with the distal end thereof in abutting engagement with said first hammering formation thereby permitting the tappet to impart hammering blows to the tool element;
   d. connection means on said driver and said shank for transferring rotation of the former to the latter and permitting axial reciprocal movement of said driver relative to said tool element and vice versa;
   e. selection means engaged with said driver for reciprocating the same axially thereby to engage and disengage said first and second sets of clutch teeth for selectively imparting rotation to said driver and to the tool element therein;
   f. said power tool having a reciprocal hammering element arranged to engage said second hammering formation thereby to impart hammering blows to said tappet;
   g. other wall means rotatably mounting said tappet and including an abutment surface; and
   h. said tappet having an abutment element arranged to abut said abutment surface thereby to establish the forwardmost position of said tappet, which tappet is out of the range of the movement of said hammering element when the former is in said forwardmost position thereof, said tappet being moved inwardly and into the range of movement of said hammering element by the engagement of the distal end of said shank with said first hammering formation.

2. The improvement according to claim 1 further defined by, said first and second clutch teeth engaging each other only at respective surfaces contained in planes radially disposed with respect to the axis of rotation of said tappet and driver, the surfaces on said first clutch teeth being slidably engaged with the surfaces on said second clutch teeth whereby said tappet transfers rotational forces only to said driver.

3. The improvement according to claim 1 wherein said connection means are defined by a multi-surface configuration of said bore and a correspondingly shaped cross-section of the shank of said tool element.

4. The improvement according to claim 1 wherein said selection means includes a manually operated rotary member mounted by said wall means and having a pin eccentric with respect to the center of rotation thereof, and scotch-yoke means on said driver and engaged with said pin.

5. In a rotary hammer power tool of the type having a motor and a drive train for rotating a nose member and for actuating a hammering mechanism, the improvement comprising:
   a. a tappet and first wall means rotatably mounting the same in co-axial relationship with said nose member;
   b. first connection means on said nose member and said tappet for transferring rotation of the former to the latter;
   c. said tappet having a first hammering formation cooperating with said hammering mechanism such that the tappet is subjected to simultaneous hammering and rotation in one axial position and to rotation only in another axial position;
d. abutment means adjacent said first wall means and adapted to be engaged by said tappet thereby to limit axial movement of the latter and to establish said positions of the tappet;
e. said tappet having a second hammering formation and a first clutch formation;
f. a rotary tool bit driver and second wall means mounting the same for rotation co-axially with said tappet, other abutment means permitting limited axial movement of said driver;
g. said driver having a centrally disposed, axial, through bore and a second clutch formation arranged for engagement with said first clutch formation thereby to permit said tappet to transfer rotation to said driver;
h. a tool element having a shank received in said bore of said driver with the distal end thereof in abutting engagement with said second hammering formation on the tappet thereby to allow alternate positioning of the tappet in said positions thereof and to allow the transmission of hammering blows from the tappet to the tool element when the former occupies said one axial position thereof;
i. second connection means on said driver and on said shank for transferring rotation of the former to the latter and permitting axial movement of the driver relative to the tool element and vice versa; and
j. selection means engaged with said driver for shifting the same axially thereby to engage and disengage said first and second clutch formations for selectively imparting rotation to said driver and to the tool element therein.

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