Sept. 28, 1965 J. S. VAUGHN 3,208,568

IMPACT TOOL

Original Filed July 18, 1958 3 Sheets-Sheet 1

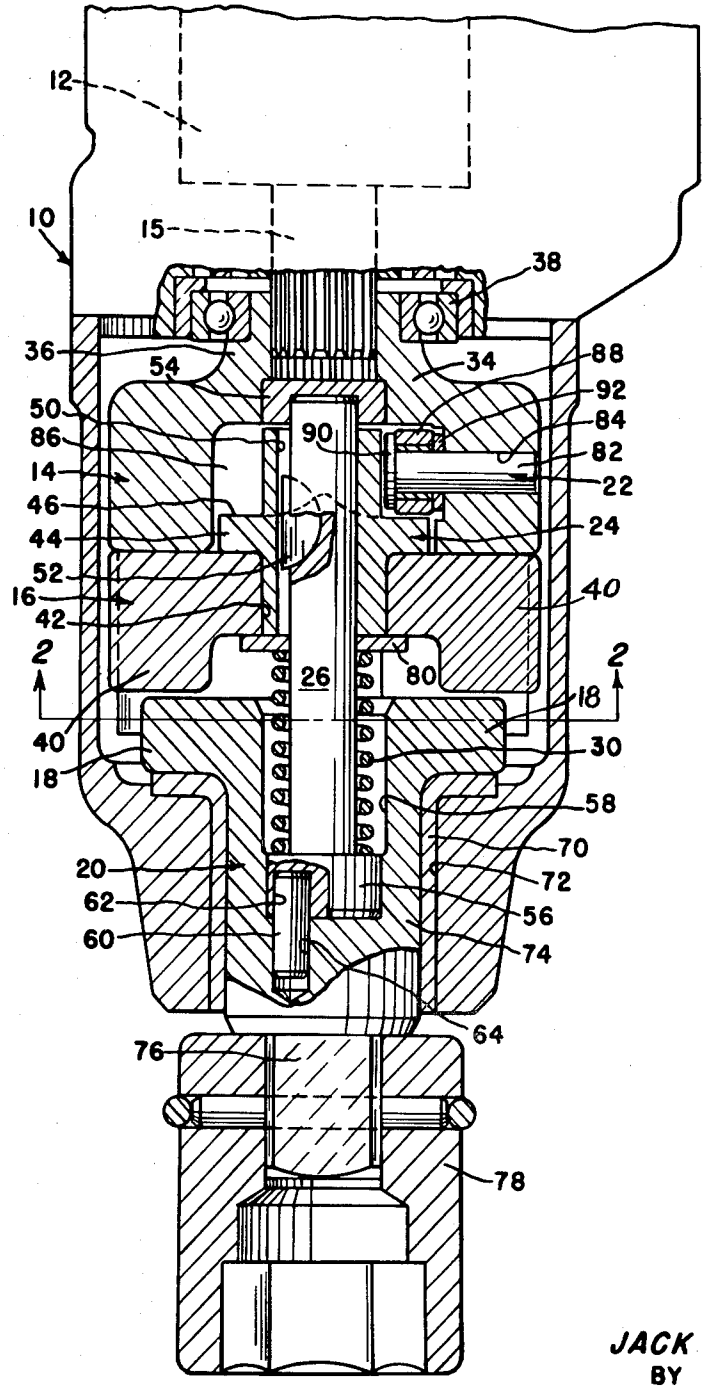


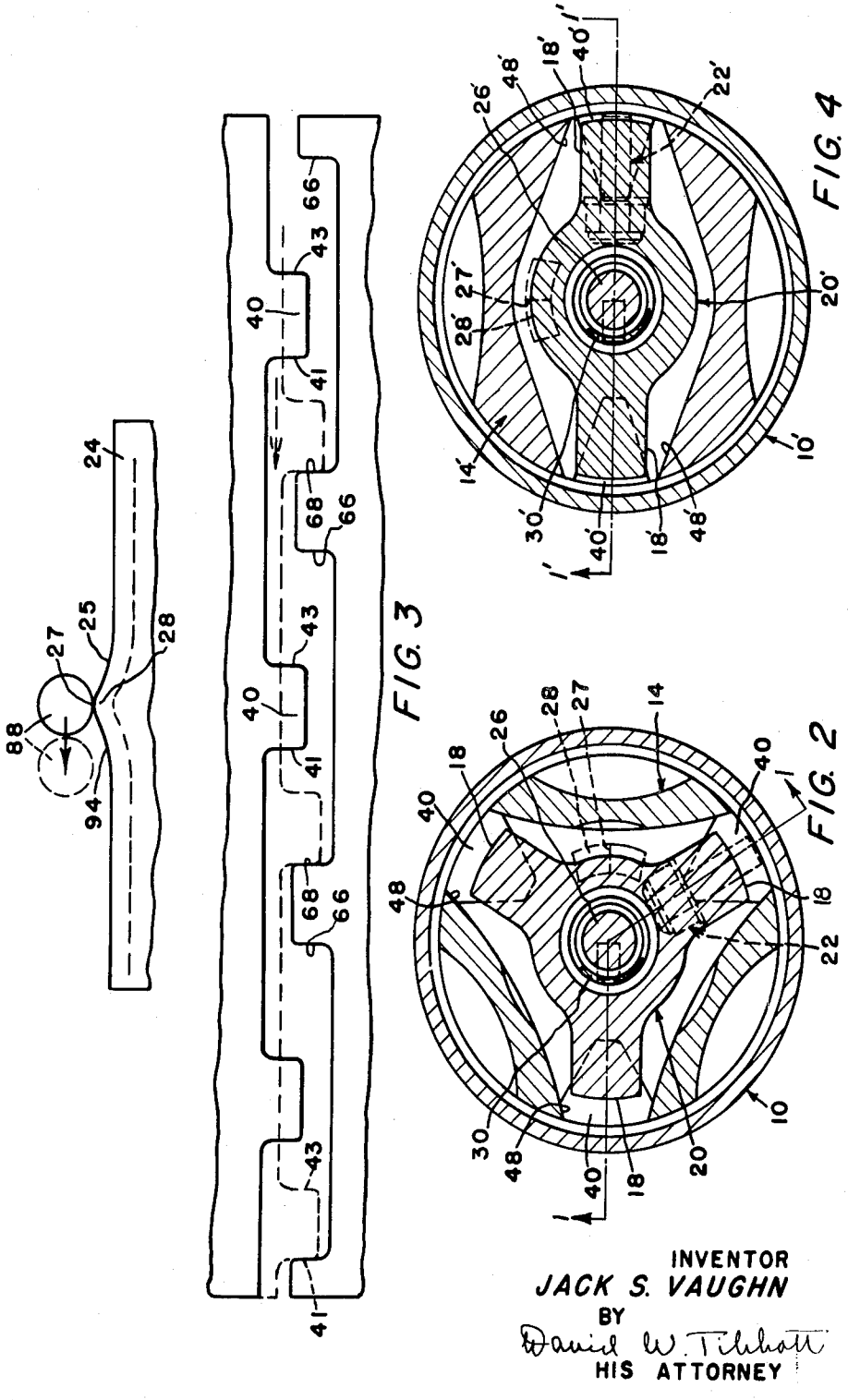
FIG. 1

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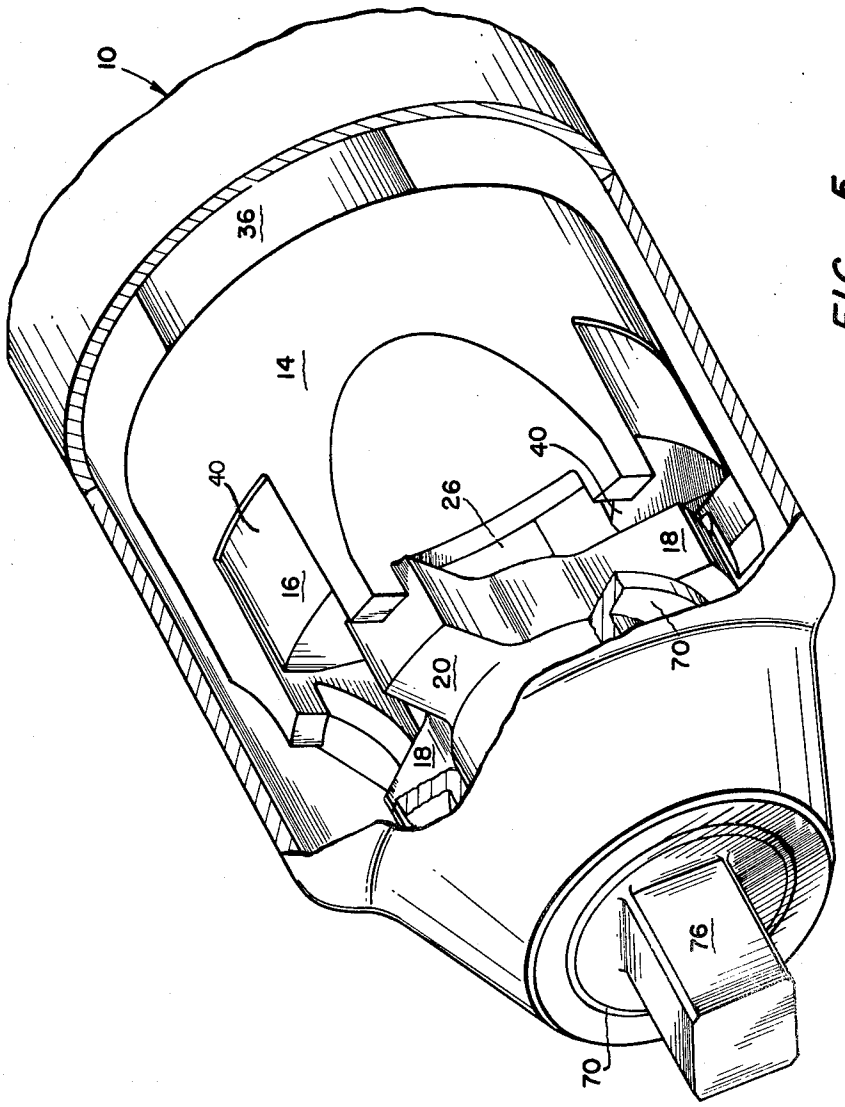


FIG. 5

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IMPACT TOOL

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Continuation of application Ser. No. 749,476, July 18, 1958. This application June 22, 1962, Ser. No. 204,461

6 Claims. (Cl. 192—30.5)

This invention relates to impact tools, and more particularly to impact tools of the type adapted to strike successive rotational hammer blows on an anvil to rotate a work element such as nuts, bolts and the like. This application is a continuation of my co-pending application Serial No. 749,476, filed July 18, 1958, now abandoned.

An object of this invention is to provide an improved and extremely simple tool construction.

Another object is to provide an improved mechanism for causing clutching and declutching action of the hammer and anvil of the tool.

These objects generally are attained by providing a tool frame, mounting a hammer in said frame for rotation about a hammer axis and having a plurality of axially movable clutch jaws, providing power means connected to said hammer to rotatively drive it, mounting an anvil rotatively in said frame in axial alignment with said hammer and having a plurality of clutch jaws adapted to be periodically engaged by the hammer clutch jaws, providing a pair of cam elements for periodically throwing said hammer clutch jaws axially toward said anvil a predetermined axial distance sufficient to cause them to rotatively impact the anvil clutch jaws, mounting one cam element on said hammer to rotate with it and preventing the one cam element from rotating relative to the hammer, mounting the other cam element on said anvil to rotate with it and preventing the other cam element from rotating relative to the anvil, and providing said cam elements with peaks angularly located about said hammer axis relative to each other where they will engage each other peak-to-peak and thrust said hammer clutch jaws axially toward said anvil when each hammer clutch jaw is angularly located approximately midway between a pair of adjacent anvil clutch jaws, shaping said cam peaks to force said hammer clutch jaws about one half of said predetermined axial distance while said cam elements remain in engagement with each other and to throw said hammer clutch jaws through the remainder of said predetermined axial distance while said cam elements are axially spaced from each other, and locating said cam peaks so that they are angularly spaced apart from each other about said hammer axis at the instant of impact between said hammer and anvil clutch jaws sufficiently for the hammer clutch jaws to be fully retracted away from said anvil after said impact without interference by said cam elements.

Other objects will become obvious from the following specification and drawings in which:

FIGURE 1 is a vertical elevation, partly in section, of the preferred form of the impact tool, the section being taken along line 1—1 of FIG. 2 and line 1'—1' of FIG. 4;

FIG. 2 is a cross sectional view of FIG. 1 taken along the line 2—2 looking in the direction of the arrows;

FIG. 3 is a development of the hammer and anvil jaws and of a portion of the clutch actuating mechanism, the solid lines indicating one position of the hammer jaw relative to the anvil and to the clutch actuating mechanism parts, and the dotted lines showing another position of the hammer jaws and clutch actuating mechanism parts;

FIG. 4 is a cross sectional view corresponding to that of FIG. 2 except that it shows a two-jaw anvil and hammer jaw construction; and

FIG. 5 is a perspective view of the impact tool shown in FIG. 1 with parts broken away showing the anvil and hammer clutch mechanism.

Referring to FIGURE 1 of the drawings, the impact tool comprises in general a casing or frame 10 housing a motor 12 connected to a shaft 15. The shaft 15 rotates a hammer 14 having a clutch 16 which is periodically actuated into engagement with the clutch 18 of an anvil 20 for delivering rotary impact blows to the anvil. The means for causing engaging movement of the clutch 16 includes a member 22, here shown as a cam follower, rotatable with the shaft 15 and hammer 14 and held against longitudinal movement relative thereto, and a second member 24, here shown in the form of a cam, longitudinally slidably mounted on a shaft 26. The shaft 26 is keyed to the member 24 and to the anvil 20 so that the cam member 24 rotates with the anvil.

With this construction of clutching mechanism, the cam follower 22 rotates with the hammer freely around the cam member 24 until the cam follower 22 engages the cam lobe 28 of the member 24. The follower 22 in traveling along the leading inclined surface 25 of the lobe 28, positively moves the cam member 24 axially forward thereby moving the hammer clutch 16 in a direction toward engagement with the anvil impact clutch 18. It is to be noted, that the operational throw or lobe height of the cam lobe 28 is substantially less than the normal travel of the hammer jaw in moving from its uppermost position (as shown in FIG. 1) to the full clutch position (the position shown in the dotted line in FIG. 3). Accordingly the hammer clutch 16 is moved positively in the direction of engagement with the anvil only during the initial portion of the engaging movement of the hammer clutch jaw; the inertia of the hammer jaw carries the hammer jaw forwardly the remaining portion of the engaging movement. In other words, the clutch actuating mechanism acts to positively move the hammer clutch jaw a portion of the engaging movement and, in effect, throws the hammer clutch jaw the remaining portion of the clutching movement. It is to be noted further that the cam follower 22 reaches the peak 27 of the cam lobe 28 substantially before engagement of the hammer 14 with the anvil 20. This position is shown by the solid lines in FIG. 3. As a consequence, the cam follower 22 will move past the cam lobe 28 before impact of the hammer on the anvil, and after impact, a spring 30 can move the hammer jaw into its fully disengaged position.

Referring now in greater detail to the construction shown in the drawings, the motor 12 may be of any conventional type, such as a vane type air motor, which is not damaged by intermittent starting and stopping. Inasmuch as these motors are well known in the art, this part of the tool is indicated only by dotted lines. The motor shaft 15 has a splined driving connection at its free end with the rearward end of the hammer 14.

The hammer shown is roughly triangular in cross sectional form (see FIG. 2) being open at its forward end and closed at its rearward end by a wall 34 carrying a boss 36 journaled in bearings 38 mounted in the casing 10. Each point of the triangle is longitudinally slotted to provide slots or notches 48 at the forward end portion of the hammer to slidably receive three jaws 40 on the hammer clutch 16. Each jaw 40 has impact surfaces on both sides thereof at 41 and 43, the sides 41 being used in right hand rotation of the hammer, and the sides 43 for left hand rotation.

A central hole 42 at the center of the clutch 16 rotationally receives the lower end portion of the cam member 24. The member 24, in the form of the invention shown, is roughly tubular in shape having an external radial flange 44 with the lower surface of the flange abutting the upper surface of the clutch element 16. Located

on the upper surface 46 of the flange 44 is the cam lobe element 28. The cam member 24 is longitudinally slotted at 50 along its central bore for the reception of a key 52 mounted on a portion of the shaft 26 extending through the bore of the cam member 24. Accordingly, the cam member 24 is longitudinally movable relative to the shaft 26, but is positively connected for rotation therewith.

The shaft 26 is supported at its rear end in a bearing cap 54 secured in the rear wall 34 of the hammer, and the forward or head end 56 of the shaft 26 is fitted in a central recess 58 in the anvil 20. The shaft 26 is keyed to rotate with the anvil by means of a pin 60 fitted at its opposite ends in holes 62 and 64 in the shaft 26 and anvil 20, respectively. Housed within the recess 58 and biased between the head 56 and a bearing plate 80 abutting the lower surface of the clutch 16, is the spring 30 which constantly urges the clutch in a direction out of engagement with the anvil 20.

It is to be noted that with this construction, the shaft 26 serves not only as a connecting member between the cam member 24 and the anvil 20, but also as a bearing support for the forward end portion of the hammer 14. The anvil 20, in turn, is rotationally supported in the forward end of the casing 10. More particularly, the anvil clutch includes three radial wings of jaws 18 to provide impact surfaces 68 on one side of each wing for cooperation with the impact surfaces 41 of the hammer. Impact surfaces 66 on the opposite side of the wings 18 cooperate with the hammer surfaces 43 when the hammer is rotated in the left hand direction. The under surfaces of these wings are supported on a wear sleeve 70 which extends through an opening 72 in the forward end of the housing to provide a bearing surface for the forward extension 74 of the anvil 20. A socket 78 is secured on a square 76 of the forward extension 74 for engaging a work element to be rotated, such as a bolt or nut (not shown).

It is to be noted that the depth of the slots 48 relative to the width of the hammer jaws 40, or alternately the position of the cam follower 22 for a given position of the cam member 24 as determined by the jaw-slot structure, by which the cam follower is positioned out of engagement with the rearward surface of the flange 44 except during the period the follower is in contact with the cam lobe 28. The purpose of this arrangement is to reduce wear on the cam follower—that is, the follower in the particular construction shown is contacted by the cam element only for approximately 30° to 40° during each complete revolution of the hammer. The spring 30 pushes against the bearing plate 80 and the bearing plate in turn moves the clutch 16 against the bottom of the slots 48 in the hammer 14. Thus, the spring 30 cannot move the cam member 24 into engagement with the cam follower 22. The particular cam follower construction shown is a pin 82 in a hole 84 in the wall of the hammer 14 and extending into the central opening 86 in the hammer. Rotatably mounted on the inner end of the pin 82 is a roller 88 held in position thereon between the head 90 of the pin 82 and a washer 92.

The operation of the tool is as follows. Assuming that a nut is being run down and tightened on a bolt, when the motor 12 is started, the hammer 14 will rotate relative to the anvil and the cam member 24 until the cam roller 88 contacts the lobe 28. The combined forces or resistance to rotation of the anvil, including the friction between the anvil and the sleeve 70, the inertia of the anvil, socket 78 and nut, plus the slight resistance to rotation offered by a free running nut, will normally result in the cam continuing to rotate relative to the anvil and cam element so that the roller travels along the lobe 28 positively forcing the cam member 24, and hence the hammer clutch 16 forwardly until the roller 88 passes clear of the lobe 28. In other words the resistance to rotation of the anvil by the work is greater than the rotational force exerted by the cam arrangement acting against the force of the spring 30. This action causes the hammer to strike a blow against the anvil, although at this relatively low resistance to rotation, the hammer jaw may at times be thrown into only partial engagement with the anvil.

A similar operational cycle occurs when the resistance to rotation of the work increases, as occurs when the nut seats, except that the increased resistance to rotation of the anvil insures that the hammer jaws will be actuated into normal engaging position with the anvil at the time a hammer blow is struck. That is, when the spring 30 returns the hammer clutch 16 to the fully disengaged position, the hammer will be accelerated by the motor 12 and rotate the cam roller 88 into contact with the lobe 28 forcing the hammer jaws 40 in a forward direction. The cam roller 88 in acting on the lobe 28 imparts sufficient forward velocity to the hammer clutch jaw 40 such that when the roller 88 approaches, or is at the peak 27 of the lobe, the inertia of the clutch 16 will carry the jaws 40 forwardly into normal engaging position relative to the anvil impact surface 68. This inertial force is sufficient to overcome the oppositely directed force exerted by the spring 30 so that as the hammer 14 continues to rotate relative to the anvil 20, the impact surfaces 41 and 68 will be in the normal desired mating position as shown in FIG. 3, the hammer jaws 40 being shown in dotted lines. Following impact, the spring 30 will return the hammer clutch 16 to its retracted position thereby declutching the hammer 14 from the anvil 20 so that the hammer is again accelerated by the motor 12 and the aforedescribed clutching and declutching action is repeated so that the hammer strikes a series of hammer blows in rapid succession against the anvil.

In the particular embodiment of the invention shown in FIG. 2, the cam follower 22 is located in line with and above a hammer jaw 40, and the cam lobe 28 is located with its peak 27 approximately midway between opposed impact surfaces 66 and 68 on adjacent anvil jaws 18. As a consequence of the relative positions of these elements, the positive clutching force exerted on the hammer jaws is completed at a time in the hammer cycle when each hammer jaw 40 is approximately midway between a pair of jaws 18 on the anvil 20 (see full lines FIG. 3. Moreover, the height of the cam lobe 28 is approximately equal to one half of the longitudinal movement of the hammer clutch 16. This construction requires the hammer clutch 16 to be thrown forwardly in order to insure engagement between the hammer 14 and anvil 20.

The purpose of this cam construction and location is twofold. First, by locating the cam lobe peak 27 approximately midway between anvil jaws 18, the tool may be operated in either direction of rotation of the hammer. Second, by locating the peak of the lobe approximately midway between the two anvil jaws and throwing the hammer into engaging position with the anvil, it is insured that the cam follower 22 will move clear of the lagging slope 94 of the lobe at or prior to impact between the hammer and anvil so that the spring can move the hammer clutch out of engagement with the anvil.

It is to be understood that the relative locations of these parts can be positioned other than as shown and still insure that the positive engaging movement of the clutch jaw is terminated at a point when the impact surface of the hammer jaw is an angular distance (e.g. 30 degrees) from the impact surface of the anvil jaw equal to or greater than the length of the portion of lagging cam slope which, if engaged by the roller, prevents disengagement of the hammer from the anvil.

In FIG. 4, a two jaw anvil 20′ and hammer 14′ construction is shown and similar numerals are used as compared to the structure shown in FIG. 2 with the exception that the numerals are primed. This view is shown merely to illustrate the relative positioning of the cam follower 22′ and cam lobe 28′. Here again, the cam follower 22′ is located over the hammer jaw 40′ and the cam lobe 28′

is positioned midway between opposed impact surfaces 66' and 68' of the anvil jaw to permit reverse rotation of the hammer.

Having described my invention, I claim:

1. An impact tool comprising:
(a) a frame;
(b) a hammer rotatively mounted in said frame for rotation about a hammer axis and having a plurality of axially movable clutch jaws;
(c) power means connected to said hammer to rotatively drive it;
(d) an anvil rotatively mounted in said frame in axial alignment with said hammer and having a plurality of clutch jaws adapted to be periodically engaged by the hammer clutch jaws;
(e) means including a pair of cam elements for periodically throwing said hammer clutch jaws axially toward said anvil a predetermined axial distance sufficient to cause them to rotatively impact the anvil clutch jaws;
(f) means mounting one cam element on said hammer to rotate with it and preventing the one cam element from rotating relative to the hammer;
(g) means mounting the other cam element on said anvil to rotate with it and preventing the other cam element from rotating relative to the anvil; and
(h) said cam elements having peaks angularly located about said hammer axis relative to each other where they will engage each other peak-to-peak and thrust said hammer clutch jaws axially toward said anvil when each hammer clutch jaw is angularly located approximately midway between a pair of adjacent anvil clutch jaws,
(1) said cam peaks being shaped to force said hammer clutch jaws about one half of said predetermined axial distance while said cam elements remain in engagement with each other and to throw said hammer clutch jaws through the remainder of said predetermined axial distance while said cam elements are axially spaced from each other, and
(2) said cam peaks being angularly spaced apart from each other about said hammer axis at the instant of impact between said hammer and anvil clutch jaws sufficiently for the hammer clutch jaws to be fully retracted away from said anvil after said impact without interference by said cam elements.

2. The impact tool of claim 1 including:
(a) means urging said hammer clutch jaws axially away from said anvil clutch jaws to disengage said hammer clutch jaws from said anvil clutch jaws after each rotary impact of said hammer clutch jaws against said anvil clutch jaws.

3. The impact tool of clam 2 wherein:
(a) said means urging said hammer clutch jaws axially away from said anvil clutch jaws is a spring located between said hammer and anvil.

4. The impact tool of claim 2 wherein:
(a) said pair of cam elements includes a roller riding on a cam having a flat and a lobe on it.

5. The impact tool of claim 2 wherein the cam element mounted on said anvil includes:
(a) a camshaft keyed to said anvil and extending axially rearwardly from it between said hammer clutch jaws; and
(b) an anvil cam slidably and non-rotatably mounted on said camshaft.

6. The impact tool of claim 2 wherein:
(a) one of said pair of cam elements comprises a cam having a flat and a lobe on it, said lobe being adapted to contact the cam element opposite said cam during said peak-to-peak engagement of said cam elements; and
(b) means for preventing said flat on said cam from being pressed against the cam element opposite said cam to eliminate friction and wear on the cam elements.

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DAVID J. WILLIAMOWSKY, *Primary Examiner.*