July 11, 1944. B. W. SNODGRASS 2,353,321

IMPACT ELEMENT ACTUATING MEANS

Filed June 6, 1941 4 Sheets-Sheet 1

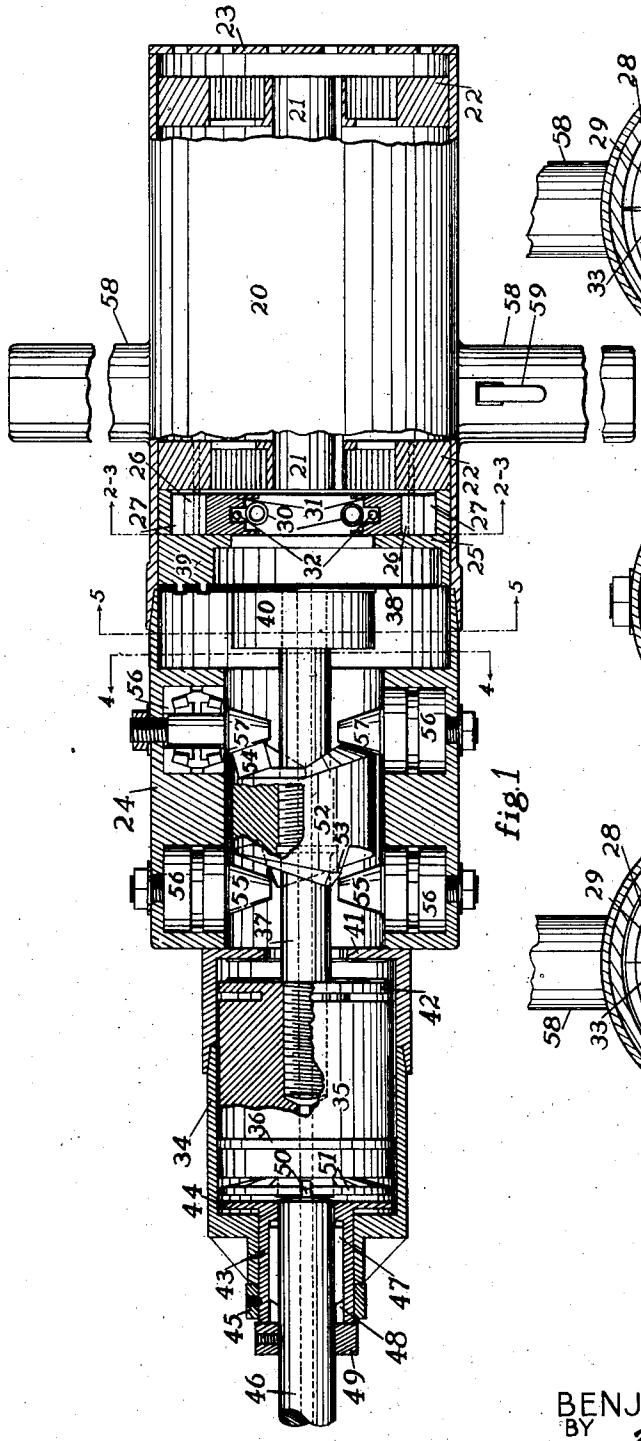

fig. 1

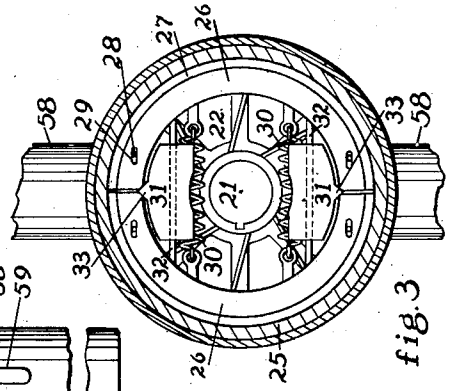

fig. 3

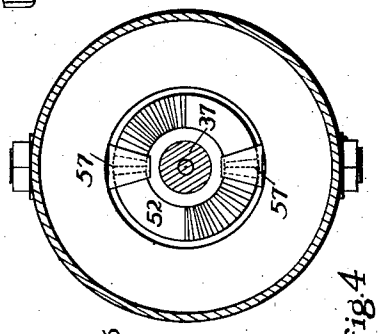

fig. 4

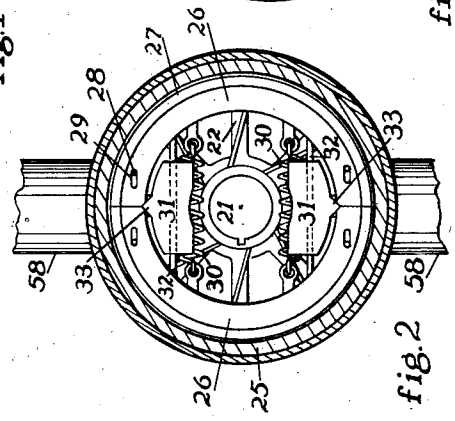

fig. 2

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IMPACT ELEMENT ACTUATING MEANS

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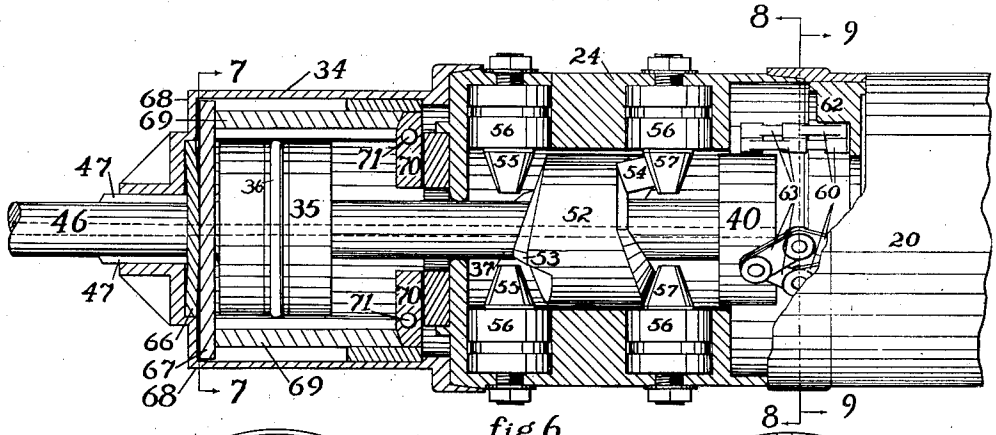

fig. 6

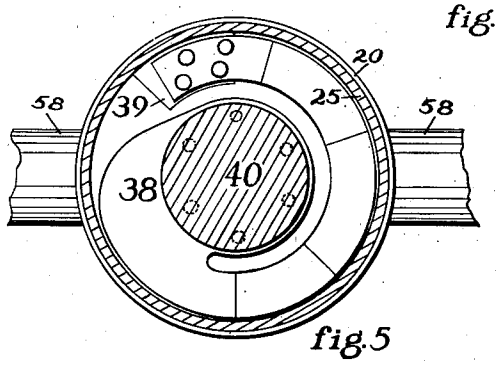

fig. 5

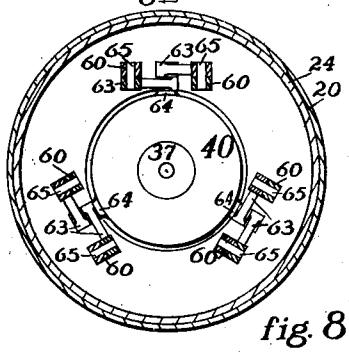

fig. 8

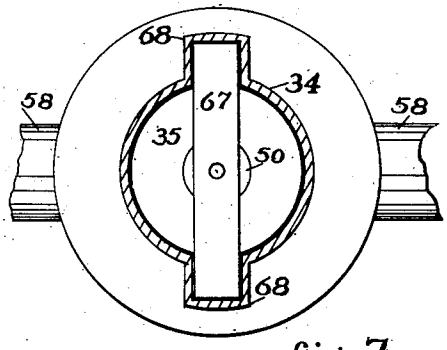

fig. 7

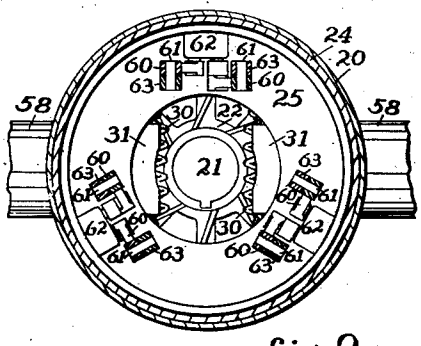

fig. 9

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IMPACT ELEMENT ACTUATING MEANS

Filed June 6, 1941 4 Sheets-Sheet 3

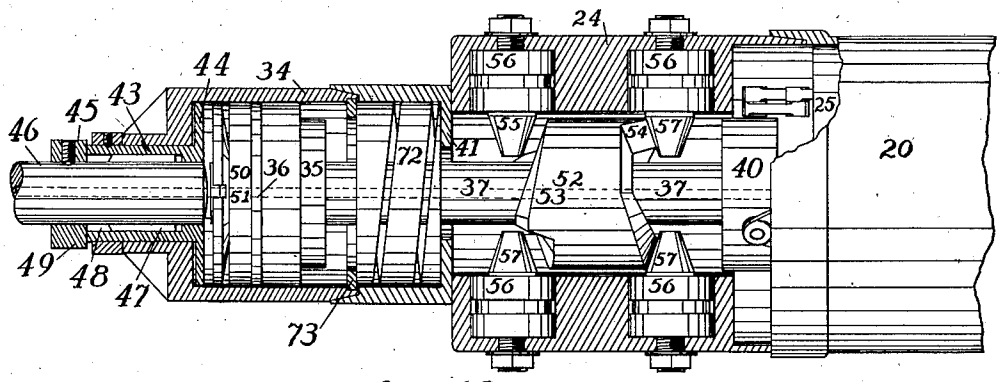

fig. 10

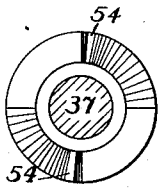

fig. 12

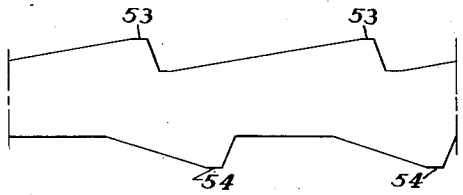

fig. 14

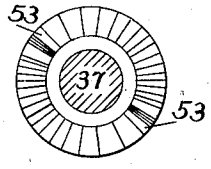

fig. 13

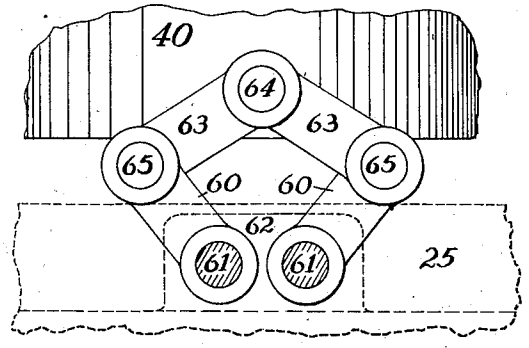

fig. 11

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July 11, 1944. B. W. SNODGRASS 2,353,321

IMPACT ELEMENT ACTUATING MEANS

Filed June 6, 1941 4 Sheets-Sheet 4

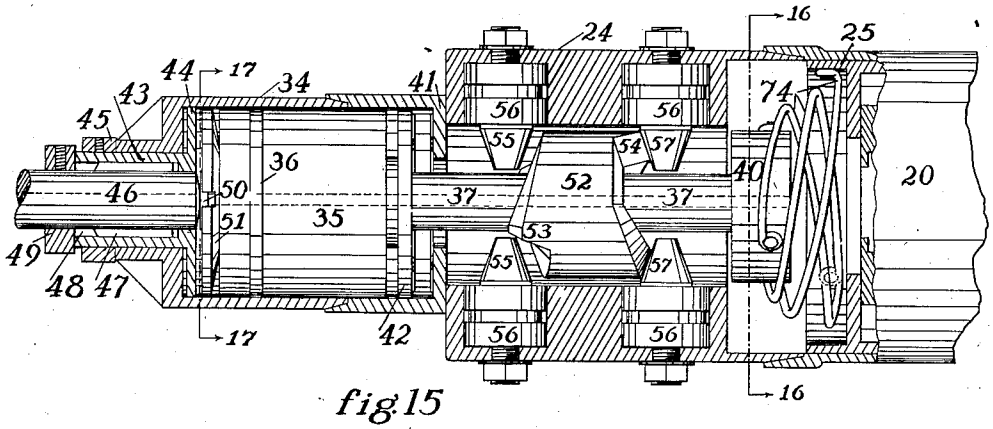

fig.15

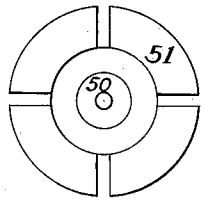

fig.17

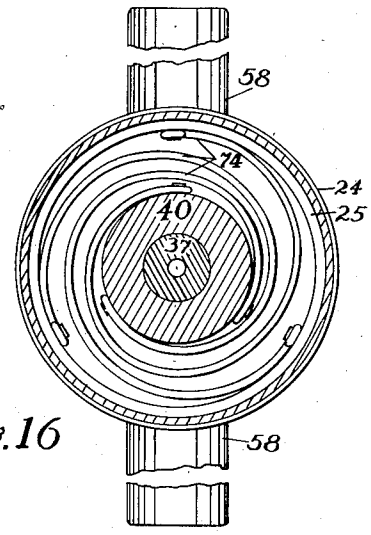

fig.16

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Patented July 11, 1944 2,353,321

UNITED STATES PATENT OFFICE

2,353,321

IMPACT ELEMENT ACTUATING MEANS

Benjamin W. Snodgrass, Denver, Colo.

Application June 6, 1941, Serial No. 396,832

8 Claims. (Cl. 255—43)

This invention relates to mechanical hammers, and particularly to such hammers adapted for actuation by a self-contained electric motor, and has as an object to provide an improved construction and combination of elements constituting a convenient and efficient tool assembly of the type described.

A further object of the invention is to provide improved means in a mechanical hammer operable to efficiently translate uniform power rotation into reciprocation of an impact element.

A further object of the invention is to provide improved means in a mechanical hammer operable to apply power from a rotating source to effect acceleration of a reciprocable impact element in both directions of impact element travel.

A further object of the invention is to provide improved means in a mechanical hammer operable to accelerate travel of a reciprocable impact element at one rate in one direction of element travel and at a different rate in the opposite direction of element travel.

A further object of the invention is to provide improved speed-responsive means automatically operable to engage and disengage an impact element assembly relative to a source of power in a mechanical hammer.

A further object of the invention is to provide improved means for operatively connecting an impact element assembly for rotation with and reciprocation relative to a power-driven rotatable element.

A further object of the invention is to provide improved means in a mechanical hammer operable to transmit impact effect developed by a reciprocable impact element at each end of its range of travel to useful work effect on a single tool.

A further object of the invention is to provide improved means in a mechanical hammer for automatic rotation of a tool operatively associated with the hammer.

A further object of the invention is to provide improved means in a mechanical hammer for feeding air to and through a tool operatively associated with said hammer.

A further object of the invention is to provide improved double-acting cam means in association with the reciprocable impact element of a mechanical hammer and operable to accelerate travel of said element in both directions of its reciprocation.

A further object of the invention is to provide an improved mounting for a reciprocable impact element in operative association with other elements of a mechanical hammer, whereby said element is accommodated for rebound at each limit of its reciprocatory travel and for acceleration subsequent to rebound in each direction of its travel.

A further object of the invention is to provide an improved mechanical hammer assembly that is conveniently portable, compact, efficient in operation, positive in action, simple of construction, and conveniently available for use wherever susceptible of connection with a source of electric power.

My invention consists in the construction, arrangement, and combination of elements, as hereinafter described, pointed out in my claims, and illustrated by the accompanying drawing in which—

Figure 1 is a section taken substantially axially through one embodiment of my improved hammer, certain elements being broken away to conserve space and to show otherwise concealed construction. Figure 2 is a cross section on the indicated line 2—2 of Figure 1 and illustrating the relative movable elements shown in said figure in one of their limiting positions. Figure 3 is a view similar to Figure 2 and illustrating the relatively movable elements of the view in the other of their limiting positions. Figure 4 is a cross section taken on the indicated line 4—4 of Figure 1. Figure 5 is a cross section taken on the indicated line 5—5 of Figure 1. Figure 6 is a fragmentary, detail section taken axially through a modified embodiment of the invention. Figure 7 is a cross section taken on the indicated line 7—7 of Figure 6. Figure 8 is a cross section taken on the indicated line 8—8 of Figure 6. Figure 9 is a cross section taken on the indicated line 9—9 of Figure 6. Figure 10 is a view similar to Figure 6 and illustrating an alternatively modified embodiment of the invention. Figure 11 is a fragmentary, detail elevation, on an enlarged scale, illustrating one of the toggle connections employed to engage between the hammer assembly and clutch ring of the hammer when constructed according to the showings of Figures 6 and 10. Figure 12 is an end view of the double-acting cam employed in the invention. Figure 13 is a view of the other end of the cam shown in Figure 12. Figure 14 is a development of the periphery of the cam unit shown in Figures 12 and 13. Figure 15 is a view similar to Figure 10 and illustrating yet another alternative embodiment of the invention. Figure 16 is a cross section taken on the indicated line 16—16 of Figure 15. Figure 17 is a cross section taken on the indicated line 17—17 of Figure 15.

In the construction of the improvement as shown in Figures 1 to 5, inclusive, the numeral 20 designates a cylindrical casing adapted to house an electric motor assembly having an armature shaft 21 disposed axially of the casing and mounted for rotation in suitable bearings (not shown) in any suitable or convenient manner. The shaft 21 extends at each end beyond the motor assembly proper and engages at each end with a fan assembly 22 fixedly associated for rotation with the shaft 21. The fan assemblies 22 may be of any suitable or desired specific construction and are illustrated as each comprising a suitable hub portion adapted to telescope over an end of the shaft 21, radial spokes fixed to and extending outwardly from the hub portion for engagement of their outer ends with a relatively heavy, circular rim, and webs on said spokes suitably twisted or inclined to urge air through the casing 20 and toward the tool or working end of the hammer assembly. The end of the casing 20 remote from the tool end of the assembly is preferably closed by means of a perforated plate 23 through which air may enter the casing 20, and the opposite end of said casing threadedly or otherwise suitably engages with an end of a cylindrical barrel 24 which is thereby mounted on and as an axial extension of the casing 20.

The open end of the casing 20 extends beyond the motor assembly and inner fan 22 a distance sufficient to provide a cylindrical recess wherein a clutch ring 25 is received and accommodated for free rotation. The clutch ring 25 includes an annular peripheral member from the mid-portion of which a continuous, radial rib extends inwardly to form oppositely-opening cups defined within said ring, one of which cups opens toward the inner fan 22 and the other of which cups opens toward the interior of the barrel 24. The clutch ring 25 is not directly connected with the shaft 21, but is arranged for cooperation at times with speed-responsive clutch elements driven by the shaft 21 in such manner as will serve to rotate the clutch ring 25 when the shaft 21 is rotating at suitable speed. While various specific arrangements of clutch means may be employed to operatively engage the clutch ring 25 with the shaft 21, the means illustrated have been found to be efficiently operable and simple of construction. As shown, identical semi-circular clutch shoes 26, preferably faced on their convex surfaces with suitable friction lagging 27, are shaped to fit within and conform peripherally with the cup or recess of the clutch ring 25 which opens toward the shaft 21, and said shoes 26 are mounted on and slidably carried by pins 28 fixed in the rim of the inner fan 22 and projecting toward the clutch ring 25 for engagement through tangentially-disposed, elongated slots 29 intersecting said clutch shoes. Retractile coil springs 30 operatively engage between the clutch shoes 26 and tend to hold said shoes in end-abutting engagement with their lagged surfaces out of contact with the inner annular surfaces of the clutch ring 25, in which relation rotation of the shaft 21 and inner fan 22 operates to freely rotate the clutch shoes 26 within and out of engagement with the adjacent cup of the clutch ring 25; such rotation of the shaft tending to subject the clutch shoes 26 to the action of centrifugal forces which urge said shoes outwardly against the tension of the springs 30 and into frictional engagement of their lagged surfaces with the adjacent clutch ring surfaces. The clutch assembly thus far described is operable to drive the clutch ring 25, but it is desired that the clutch used be definitely more responsive to rotative speed of the shaft 21 and that the grip between the clutch shoes 26 and ring 25 be maintained through minor speed variations after it has once been established, and to that end a pair of weight blocks 31 is associated with the clutch shoe assembly for reaction to the centrifugal forces generated by rotation. Each of the blocks 31 is disposed between a spring 30 and the adjacent abutted ends of the shoes 26, and is slidably supported on aligned arms 32 extending inwardly in fixed relation from the shoes 26 in perpendicular relation with the diameter on which the shoes 26 separate, and each of said blocks 31 carries a radially-disposed wedge point 33 positioned between the slightly beveled corners of the abutted ends of the clutch shoes 26, so that, as the blocks 31 tend to move radially and outwardly under the centrifugal forces of rotation, the points 33 operate to wedge apart adjacent ends of the clutch shoes 26 and urge the lagged surfaces of said shoes into gripping engagement with the adjacent clutch ring surface. As will be apparent, the blocks 31 tend to hold the shoes 26 in clutching engagement with the ring 25, as shown in Figure 3, against minor variations in the speed of rotation, and thereby operate to preserve clutched engagement of the ring 25 with the shaft 21 when once such relation has been established. For convenience in mounting and positioning of the blocks 31, said blocks may be formed with inwardly-projecting, spaced webs adapted to overlie and partially house the corresponding springs 30.

The end of the barrel 24 remote from the casing 20 is formed with or suitably connected to an axially-aligned tubular housing 34 of reduced diameter which interiorly communicates with said barrel 24, and the free end of the housing 34 is closed save for a tool-receiving aperture, hereinafter more specifically described. The housing 34 provides a cylindrical slide bearing in which is received a cylindrical impact element 35, of considerable mass, therein accommodated for rotation and axial reciprocation, said element 35 preferably being provided with one or more circumferential, radially-projecting, bearing rings 36 of suitable wear metal adapted to engage the inner surface of the housing 34. A rigid stem 37 is suitably and preferably adjustably engaged with the impact element 35 and extends in axial coincidence with said element and with the barrel 24 substantially through said barrel and toward the casing 20, said stem 37 being thus axially aligned with the shaft 21. The stem 37 is fixed to the impact element 35 against rotational or axial displacement relative thereto, so that any movement imparted to the stem 37 is transmitted to effect corresponding movement of the element 35. The end of the stem 37 remote from the element 35 is connected with the cup of the clutch ring 25 opening toward the barrel 24 in such manner as to connect said stem and clutch ring for simultaneous rotation and to permit axial reciprocation of said stem relative to said ring, and such connection is illustrated in Figures 1 and 5 as comprising a flat, spiral spring assembly 38 fixed at one end to a boss 39 formed integrally with the clutch ring 25 and at its other end to a head 40 fixedly

carried on the otherwise free end of the stem 37. The spring 38 may be of any desired specific construction suitable to its purpose, but is preferably in the form of a plurality of thin laminations of varying lengths, all of said laminations being fixed to the boss 39 and only certain of the laminations connecting with the head 40, the laminations which do not extend to connection with the head 40 terminating at various points along the length of the spring to progressively stiffen the spring action toward the point of attachment to the boss 39. The spring 38 is relatively wide radially of the barrel 24 and is substantially unyielding in a radial direction, hence rotation of the clutch ring 25 is directly and positively transmitted to effect rotation of the head 40, stem 37 and element 35 while the yieldability of the spring 38 in a direction axially of the barrel 24 permits free, limited reciprocation of the impact element assembly.

Reciprocatory travel of the element 35 axially of the housing 34 is positively limited at each end of its stroke by rebound engagement of the element against suitable abutments. Adjacent the junction of the housing 34 with the barrel 24 is positioned an annular web or flange 41 disposed perpendicularly to the axis of the housing assembly in position for engagement by a disc-like, stiff spring member 42, formed on the adjacent end of the element 35, when said impact element approaches the corresponding limit of its range of travel. The web 41 and spring 42 are both slightly yieldable under impact, but are stiff enough to absorb the force of impact with little distortion and to initiate almost instantaneous rebound of the element 35 as a result of engagement between said members. At its free end, the housing 34 is provided with a cylindrical, axial bore wherein is slidably and rotatably seated a sleeve 43 formed with an annular flange 44 on and projecting radially and outwardly from its inner end within the housing 34. The outer end of the sleeve 43 preferably projects beyond the housing 34 and carries an adjustable collar 45 suitably fixed to said sleeve to limit axial displacement between said sleeve and the housing bore in one direction and adjustable to vary the amount of axial play permitted between said sleeve and housing. The sleeve 43 has an axial bore opening through the flange 44 and adapted to receive and operatively seat the impact end of a tool 46, such as a drill, or the like, thus disposed to be acted upon by the hammer assembly. The bore of the sleeve 43 and the tool end received therein are preferably arranged for simultaneously-rotatable, relatively-slidable engagement, it being common practice to provide longitudinal fins 47 on the tool end for engagement within longitudinal slots 48 in and opening through the outer end of the sleeve. A collar 49 is commonly provided on and sometimes in adjustable relation with the tool end to limit extension of the tool inwardly of the sleeve 43 and to provide convenient means for loosely holding the tool against separation from the sleeve, and said collar 49 is positioned on the tool 46 so as to permit extension of the tool end entirely through the sleeve 43 and slightly beyond the inner face of the flange 44. With the arrangement shown, the inner end of the tool 46 is positioned and held for impact engagement by a central boss 50, projecting slightly from the adjacent face of the element 35, as said element approaches the outer limit of its range of travel, such impact effect being transmitted to and through the tool 46 for useful work effected by the other end of the tool. The end of the impact element 35 adjacent the tool 46 is formed as an outwardly-diverging, radially-notched, conical spring 51 having an outer face adapted to engage at times against the inner face of the flange 44, so that, in the event the tool 46 is not fully seated in its sleeve 43 or in case said tool yields under impact and fails to absorb the inertia force transmitted by the element 35, the outer face of the spring 51 may engage the flange 44, move said flange and its associated sleeve 43 until the flange engages the end of the housing 34, and then initiate rebound travel of said element without damage to the structural elements of the assembly. As was stated in connection with the flat spring 42, the spring 51 is sufficiently stiff as to yield very little upon engagement with the flange 44 and housing end, so that rebound travel of the element 35 is promptly initiated upon such engagement.

The arrangement of flange 44 and spring 51 as shown and above described has a further function in providing means for automatically rotating the tool 46. Since the element 35 is rotatively driven during operation of the tool assembly, the conical spring 51 is correspondingly rotating while the sleeve 43 and its flange 44 are stationary. Thus, impact engagement of the rotating spring 51 against the inner face of the non-rotating flange 44 exerts considerable torque which tends and actually does operate to rotate said flange and the sleeve 43 during the instant of engagement between the spring and flange, the mounting of the tool 46 in the sleeve 43 being such as to cause rotation of the tool when the sleeve is rotated.

Rotation of the impact element assembly deriving from power rotation of the clutch ring 25 through the agency of the clutch means previously described is utilized to reciprocate the impact element for desired work effect on the tool 46, and such reciprocation is accomplished through means operable to accelerate impact element travel in both directions of oscillation and to entirely free the impact element from any limiting or inhibiting influences just before, during, and immediately after engagement of said element with rebound-initiating structure at the ends of its strokes. In this manner, rebound of the impact element is utilized to initiate its reverse travel at each end of its stroke; the element is freed for full utilization of its inertia for work effect and rebound; abnormal strains on structure are obviated; and progressive acceleration of the impact element may efficiently be had with a minimum input of power.

Reciprocation of the impact element assembly is accomplished as an incident of impact element assembly rotation through the use of a compound cam member 52 carried by the stem 37 and disposed for alternate engagement of its cam faces with and against cam followers rotatably fixed in paired relation within the barrel 24. The cam 52 preferably takes the form of a substantially cylindrical member adjustably fixed on and in axial coincidence with the stem 37 approximately midway between the element 35 and head 40, the opposite end margins of said cylinder being formed as double-lobed cam faces. The cam peaks on the cam face directed toward the impact element 35 are indicated by the numeral 53, and the peaks on the cam face directed toward the head 40 are indicated by the numeral 54, the peaks on each of the cam faces being separated by 180 degrees. Disposed in axial alignment dia-

metrically of the barrel 24, a pair of cam followers 55 is positioned interiorly of said barrel adjacent the web 41 and in position for operative engagement at times by the cam face carrying the peaks 53. The followers 55 may be of any suitable, specific construction and relation with the barrel 24, adapted to their function and purpose, but a preferred construction is illustrated as including a frusto-conical bearing head on each said follower, a cylindrical stem portion integral with said head and mounted for rotation in suitable anti-friction bearings 56 engaging between the stem and pertinent portions of the barrel 24, and means for limiting axial displacement of the followers relative to the barrel. The followers 55 are positioned with their bearing heads in opposition on opposite sides of the stem 37, and the cam face carrying the peaks 53 is beveled to correspond with the taper of the follower heads and is so related, as by means of adjustment of the cam 52 on the stem 37, as to leave a small but definite space between the flat spring 42 and the web 41 when the peaks 53 are engaged with the followers 55, and to leave a corresponding small but different definite space between the troughs of said cam face and the follower heads when the conical spring 51 is in full bearing engagement against the annular flange 44 of the sleeve 43 at the outward extension limit of said sleeve relative to the housing 34. It is the function of engagement between the cam face bearing the peaks 53 and the followers 55 to accelerate the impact element 35 in its direction of travel away from the tool 46, and to release the impact element assembly for free final travel and rebound from the web 41 prior to engagement of the spring 42 with said web. To accomplish this function, the working face of the cam is inclined uniformly and gradually from the maximum trough adjacent one peak to the apex of the opposite peak, and drops away very rapidly from each peak to the trough adjacent and in trailing relation therewith. With this arrangement, rotation of the impact element assembly carrying the cam 52 results in engagement of the inclined cam faces leading to the peaks 53 with the heads of the followers 55 as the impact element 35 rebounds from the tool 46 or flange 44, which engagement of the cam face serves to accelerate travel of the impact element assembly away from the tool 46 until the peaks 53 clear the followers 55, whereupon the impact element assembly is released from any axial driving influence and is free for impact of its spring 42 against the web 41. The cam face adjacent the head 40 is arranged for engagement at times with followers 57, in all essential respects identical with the followers 55, which are disposed in axial alignment diametrically of the barrel 24 between said cam face and the head 40 in such spacing with the followers 55 as will permit the cam peaks 54 to pass over and clear the followers 57 just before the impact element or its spring 51 engages the tool 46 or flange 44 for rebound therefrom. It is the function of engagement between the cam face carrying the peaks 54 and the followers 57 to accelerate travel of the impact element assembly toward the tool 46, and for this purpose the cam peaks 54 are offset angularly from the position of the cam peaks 53, the cam face drops off sharply behind the peaks 54 to provide troughs of a depth sufficient to prevent engagement of that portion of the cam face with the followers 57 when the impact element 35 is at the limit of its travel away from the tool 46, and the cam face between each trough and the following peak 54 is inclined to accelerate axial travel toward the tool as an incident of rotation imparted to said assembly and the cam. It is contemplated that the inclination of the operating cam faces on both ends of the cam body may be similar, in which event acceleration of the impact element assembly will be uniform in each direction of its travel. However, a characteristic of the invention is a more rapid acceleration of the impact assembly travel toward the tool than away from the tool, and this is conveniently accomplished by shortening the length and increasing the inclination of the cam working faces adjacent and leading to the peaks 54, as is clearly shown in Figure 14. Since the circumferential length of the cam track between adjacent peaks is the same on each of the cam faces, shortening and steepening of the working cam faces adjacent the peaks 54 is conveniently accomplished by extending the length of the troughs following said peaks.

With the cam arrangement shown and described, rotation of the impact element assembly deriving from rotation of the clutch ring 25 through the agency of the clutch shoes 26 and motor shaft 21 operates to repetitiously reciprocate said impact element assembly through the following cycle; with the elements positioned as shown in Figure 1, the peaks 54 are just about to clear their followers 57, thereby completing acceleration of the impact element toward the tool 46 and releasing said element just prior to its engagement with said tool for free travel and rebound; further rotation of the assembly during the initial rebound travel bringing the cam faces leading to the peaks 53 into engagement with their followers 55 during the rebound travel of the element, thereby accelerating such rebound travel away from the tool until the peaks 53 clear their followers 55 just prior to impact engagement between the spring 42 and web 41, thereby freeing said element during the period of its rearward impact and rebound; said element then continuing to travel forwardly toward the tool under the impetus of its last rebound until the steeper cam faces leading to the peaks 54 engage their followers 57 and rapidly accelerate forward travel of the element toward the tool until said peaks 54 clear their followers 57. In this manner, acceleration is applied to the impact element travel during continuous uniform rotation of said element and while said element is moving in a direction corresponding to the direction of acceleration; rebound effect being utilized to initiate travel of the element prior to the application of power acceleration thereto.

As has been previously pointed out, the fans 22 are constructed and arranged to draw air through the plate 23 for cooling of the motor assembly carried within the casing 20, and the flow of air thus induced is delivered to the interior of the barrel 24 and may be utilized for clearing the working face of the tool 46 during actuation of the impact element assembly. For this purpose it is convenient to provide an air passage or bore extending entirely through the impact element 35, stem 37 and head 40 in alignment with a similar bore commonly provided in drill tools, and the like. There will be a normal air flow through the passages thus provided whenever the motor is operated, and there is a jet action at the working face of the tool whenever the impact element assembly is reciprocating, since the impact element 35 and its spring 51 act as a plunger to compress air adjacent the

inner tool end and drive the trapped air outwardly through the bore in the tool.

For convenience in manipulation, suitable handles 58 may be provided on the casing 20, and one of said handles may conveniently carry a switch 59 for control of motor operation.

In the modified construction illustrated in Figures 6 to 9, inclusive, the operative principle and essential characteristics of the invention are substantially the same as those hereabove described, the only differences being structural and involving the use of alternative means for connecting the impact element assembly with the clutch ring 25 and a modification of the impact element mounting whereby said element is arranged for work effect on the tool at each limit of its range of reciprocation. As shown in the figures last above noted, the spiral spring 38 connecting between the clutch ring 25 and head 40 is omitted and operative connection between said elements is accomplished through the agency of a plurality of toggle assemblies. The toggle assemblies may conveniently be three in number, identical in construction, and angularly spaced uniformly between the elements to be connected, and each of said assemblies may conveniently take the form of a pair of identical links 60, each hinged at one end by means of a pin 61 to a suitable boss 62 carried by the cup of the clutch ring 25 which opens to the barrel 24 and thus disposed to extend in diverging relation toward the adjacent head 40. Another pair of links 63 is hingedly mounted on a common pin 64 projecting radially from and in fixed relation with the head 40, and said links 63 diverge from their pin 64 toward and are respectively hingedly connected as at 65 with the corresponding ends of the links 60, thus completing the toggle. As will be apparent, the toggle assemblies just described serve to link the impact element assembly to and for rotation with the clutch ring 25, while accommodating axial reciprocation of the impact element assembly relative to said ring.

In the modification of the impact element mounting shown in Figures 6 and 7, the springs 42 and 51 of the impact element are omitted, the sleeve 43 is adjusted against axial play relative to the housing 34, or is entirely omitted, and the tool 46 is adjusted to extend inwardly of the housing 34 into end engagement with the central portion of a cupped disc spring 66 which is received within the housing 34 in bearing relation of its central portion against a strike bar 67 disposed diametrically of said housing. Diametrically-opposite, radially-projecting, longitudinally-disposed channels 68 are formed in the walls of the housing 34 and open interiorly of said housing to receive the ends of the strike bar 67 and to accommodate rigid plungers 69 each engaging at one end with the corresponding end of the strike bar 67 and extending in parallel relation with the impact element axis to engagement of their ends against slightly beveled corners of hinged actuating arms 70 positioned radially of and within the housing 34 adjacent the impact face of the web 41 in position for engagement of their free ends by the impact element as the latter approaches the limit of its travel away from the tool 46. The actuating arms 70 are provided with suitable fulcrums 71 closely adjacent their zone of engagement with the plungers 69, so that the lever arm engaged by the impact element is longer than the lever arm acting against the plunger 69, and said arms 70 operate under impact derived from the element 35 to transmit a considerable portion of the impact force through the plungers 69 and strike bar 67 to and for work effect on the tool 46; direct impact of the element 35 on the strike bar 67 being transmitted through the spring 66 directly to the tool. In this manner the force of impact developed at each end of the impact element travel is transmitted to and for work effect on tool 46.

The modified construction illustrated by Figure 10 is something of a combination of the arrangement of elements shown in Figures 1 and 6, the functional and operative characteristics of the last noted modification being identical with those previously described. In the showing of Figure 10, the impact element assembly and the clutch ring 25 are operatively connected by means of the toggle arrangement engaging between said clutch ring and the head 40 in the manner shown and described in connection with Figure 6, and the impact element mounting is the same as is shown and described in connection with Figure 1, save that a heavy, stiff, coil spring abutment 72 is positioned forwardly of the web 41 for engagement by the impact element 35 at the rearward limit of its range of oscillation. The spring abutment 72 is preferably held against forward travel in the housing 34 by means of a shoulder or retaining ring 73, and the impact element 35 is preferably formed with an end portion 35' adapted to engage through the ring 73 and with the opposed face of the spring abutment 72.

The modified construction illustrated in Figures 15 and 16 is functionally and operatively identical with the arrangement shown in Figure 1, the only structural difference involving substitution of a plurality of spiral spring connections 74 in place of the flat spring 38. The connections 74 preferably take the form of wires spirally contoured for connection of their outer ends to the clutch ring 25 and of the inner ends to the head 40, said connections 74 being provided in suitable number and disposed in spaced relation to provide a drive somewhat yieldably connecting the impact element assembly for simultaneous rotation with the clutch ring while permitting axial reciprocation of said impact element assembly relative to said clutch ring.

It will be obvious that the illustrations of the drawings do not exhaust the possibilities of structural modification inherent in the invention without departure from the operative principle of the improvement, and that the individual modifications illustrated may be variously combined in a single operative unit in full accord with the fundamental principle of the invention, hence I wish to be understood as being limited solely by the scope of the appended claims rather than by any details of the illustrative showing and foregoing description.

I claim as my invention:

1. A mechanical hammer, comprising a housing, an impact element mounted for rotation and axial reciprocation in and adjacent one end of said housing, spaced rebound abutments carried by said housing for alternative engagement by opposite ends of said impact element to limit reciprocatory travel thereof, a stem fixed to and projecting axially from said impact element through one of said abutments toward the opposite end of said housing, a double-acting cam fixed to said stem, cam followers carried by said housing and alternately engageable by opposite working faces of said cam to reciprocate said

impact element, said cam followers and their respective cam working faces being so associated as to engage for actuation of said impact element only when the latter is out of contact with said abutments, and power means in said housing operatively engageable with and for rotation of said stem, cam and impact element.

2. A mechanical hammer, comprising a suitable housing, tool-receiving means in one end of said housing, an impact element mounted for rotation and axial reciprocation in the end of said housing adjacent and for impact engagement against said tool-receiving means, a rebound abutment fixed in said housing to limit travel of said impact element away from said tool-receiving means, a stem fixed axially to said impact element and extending through said rebound abutment toward the end of said housing, a speed-responsive clutch assembly in said housing, a power unit in driving engagement with one element of said clutch assembly, axially-yieldable, rotatably-effective means connecting the other element of said clutch assembly with said stem, and double-acting cam means fixed to said stem for engagement during rotation of the latter with followers fixed in said housing to translate rotation of said stem into axially-accelerated reciprocation of said impact element.

3. In a mechanical hammer, an impact element mounted for rotation about its axis and simultaneous axial reciprocation between spaced rebound abutments, tool-receiving means in one of said abutments, a power unit in rotatively-driving relation with said impact element, and means for translating rotation of said element into reciprocatory acceleration thereof in both directions of its oscillation, said means comprising an axial stem projecting from said element, a cylindrical body fixed to said stem, cam tracks on the opposite ends of said body, and cam followers fixed in spaced relation for cooperation with an adjacent cam track when said impact element is out of contact with either of said rebound abutments.

4. In a mechanical hammer having an impact element mounted for simultaneous rotation and axial reciprocation, a stem fixed axially of said impact element and power means in rotatably-driving relation with said stem, means for accelerating reciprocatory travel of said impact element in both directions of its oscillation, said means comprising a cylindrical cam body fixed to said stem, a cam track on one end of said body, followers engageable at times with said cam track and operable to shift the impact element axially in one direction during arcuate travel of said cam body, a second cam track on the opposite end of said cam body, cam followers engageable at times by said second cam track and operable during rotation of said cam body to shift said impact element axially in the opposite direction, and cam peaks on both of said cam tracks contoured to release said tracks from their respective followers prior to impact engagement of said impact element with its associated reciprocation-limiting structure.

5. In a mechanical hammer having an impact element assembly mounted for simultaneous rotation and axial reciprocation, and means for rotating and reciprocating said assembly, a tool disposed in axial alignment with said assembly and positioned for impact engagement by said assembly at one limit of its range of reciprocation, means operable as an incident of impact element assembly rotation to intermittently rotate said tool, said means comprising a sleeve mounted for rotation and limited axial displacement in axial alignment with and adjacent the impact end of said assembly, an axial bore in said sleeve adapted to receive the end of the tool and mount the latter for rotation with and axial travel relative to said sleeve, an annular flange on and extending radially and outwardly from the end of said sleeve adjacent said impact element assembly, and a frusto-conical flange on the adjacent end of said impact element assembly frictionally engageable upon impact of said assembly against said sleeve and tool with said sleeve flange to transmit rotation of said impact element assembly for brief, intermittent, rotative effect on said sleeve and the tool.

6. In a mechanical hammer having a housing, an impact element assembly mounted for simultaneous rotation and axial reciprocation in one end of said housing, a tool provided with an axial channel carried by and extending through the end of said housing adjacent said impact element assembly, and a power shaft rotatably mounted in the other end of said housing in axial alignment with said impact element assembly, means for jetting air through the channel of said tool, said means comprising an air intake in the end of said housing adjacent said power shaft, fan means fixed to said shaft for rotation therewith and arranged to draw air inwardly of said intake and deliver said air interiorly of said housing, an axial bore opening entirely through said impact element assembly and adapted to align with the channel in said tool, and a flange on the working end of said impact element assembly adapted to function with plunger effect during reciprocation of said assembly and thereby force air fed through said assembly through and for jet effect outwardly of said tool.

7. In a mechanical hammer having an impact element mounted for rotation and simultaneous axial reciprocation between spaced rebound abutments, and means for rotating and reciprocating said element, means for facilitating non-destructive rebound of said impact element from said abutments, said means comprising integral, annular, marginally-yieldable springs formed on, spaced axially from, and disposed for travel with the opposite ends of said impact element and adapted for impact engagement against their respective abutments.

8. In a mechanical hammer having an impact element mounted for reciprocation axially of a housing and power means for actuating said element, means for utilizing impact effect of said element at each end of its range of reciprocation for work effect on a single tool, said means comprising a tool end supported in and projecting through one end of said housing in axial alignment with said impact element, a strike bar diametrically of said housing and engaging the end of said tool in the path of said impact element, plungers engaging the ends of said strike bar and disposed on opposite sides of said impact element and in axially-parallel relation therewith, and pivoted arms disposed radially of said housing with their outer ends in bearing engagement against the ends of said plungers remote from said strike bar and their inner ends positioned for impact engagement with said impact element as the latter reaches its limit of oscillation remote from said strike bar and tool.

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