

July 6, 1943.

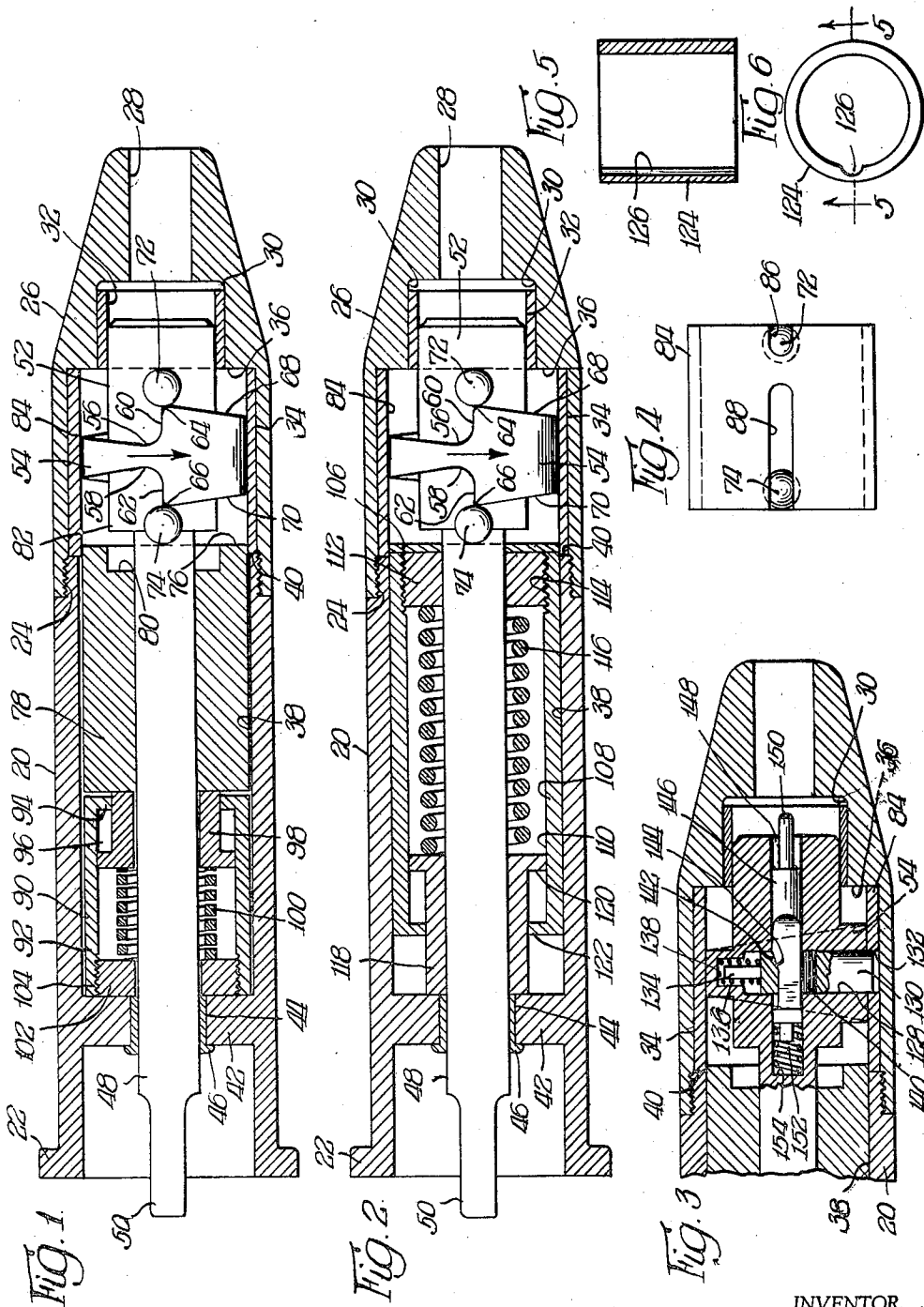
K. C. BUGG

2,323,375

TOOL

Filed Dec. 26, 1941

3 Sheets-Sheet 1



INVENTOR.

Kently C. Bugg.

BY

Atkinson, Thayer, Pyron & Knight

July 6, 1943.

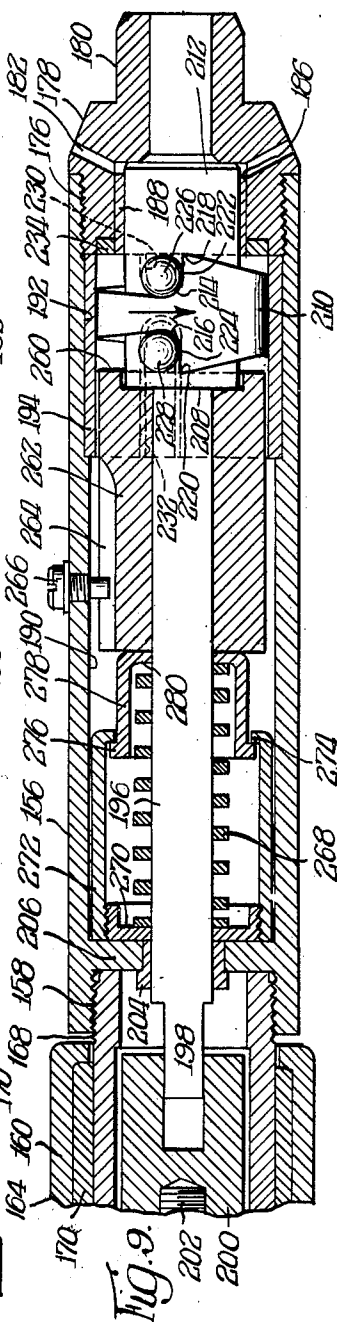
K. C. BUGG

2,323,375

TOOL

Filed Dec. 26, 1941

3 Sheets-Sheet 2



INVENTOR.

Kerly C. Bugg,

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Hickinson, Hughes, Byron & Keats

July 6, 1943.

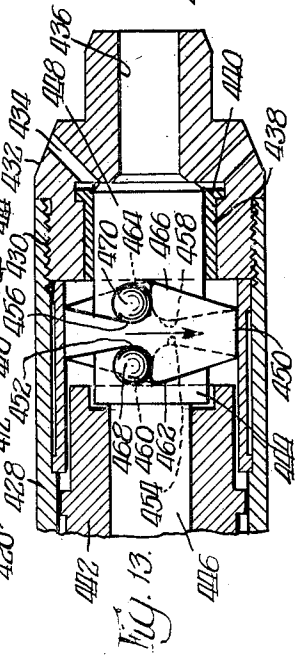
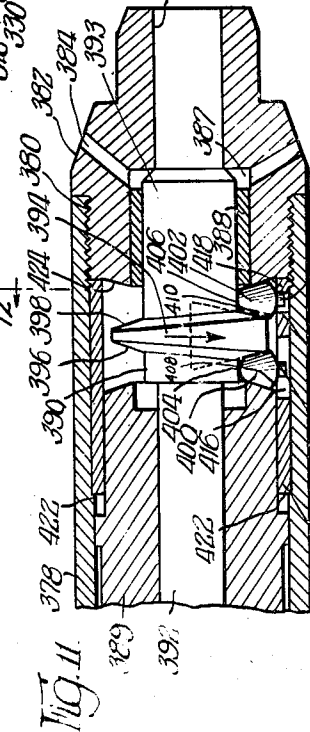
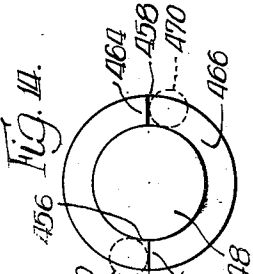
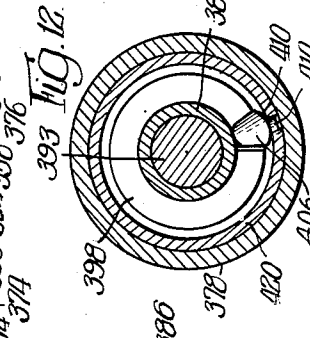
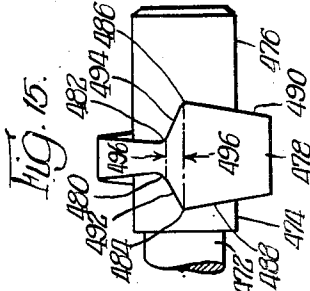
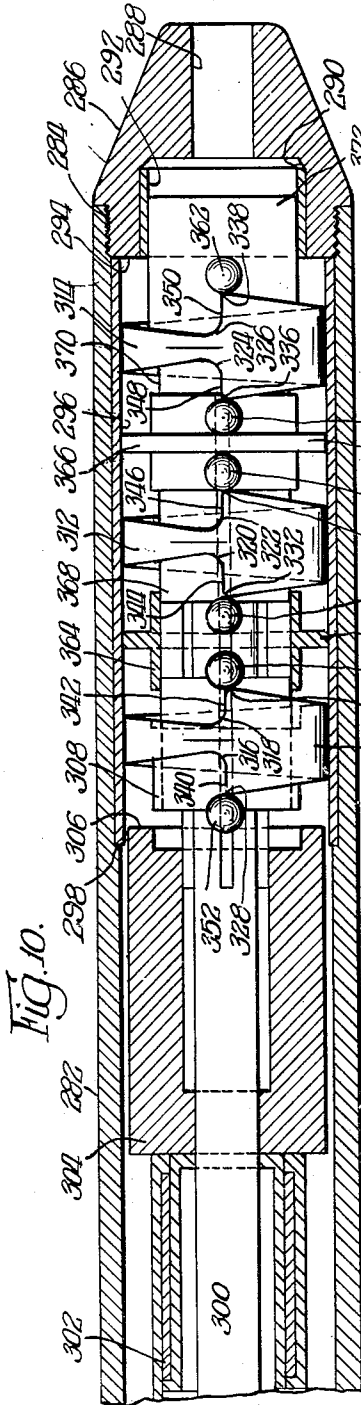
K. C. BUGG

2,323,375

TOOL

Filed Dec. 26, 1941

3 Sheets-Sheet 3



INVENTOR.
Kerly C. Bugg,
BY
Atkinson, Hughes, Paxon & Kniffet
1943.

UNITED STATES PATENT OFFICE

2,323,375

TOOL

Kenly C. Bugg, Fort Wayne, Ind.

Application December 26, 1941, Serial No. 424,389

23 Claims. (Cl. 125—33)

This invention pertains to percussion tools and more particularly to power actuated hammers.

It is an object of this invention to provide a percussion tool such as a power driven hammer, wherein a captive spring is utilized to prevent rotation of the blow delivering member, thereby eliminating friction which would cause heat to be generated.

Still another object of the invention is to provide a percussion tool wherein two rotating members are provided on opposite sides of a double cam rise, in order to function as an anti-friction thrust bearing and loading means, while the power storing means, such as a spring, is being compressed, whereby the power storing means is not rotated and whereby the thrust bearing is thus only operative during the compression cycle.

Yet another object of the invention is to provide a percussion tool where the power storing means is not rotated, and wherein the double cam rise and the associated mechanism is so constructed and arranged that anti-friction bearings per se need not be used.

A further object of the invention is to provide a percussion tool wherein a double cam rise mechanism is provided for storing energy and permitting a delivered blow, and wherein at least twice the normal lift is obtained over constructions wherein only a single rise is utilized.

Still a further object of the invention is to provide a percussion tool wherein a captive spring is utilized for storing energy, preventing contact between the spring and the blow delivering hammer portion of the tool or any rotating means therein.

Yet a further object of the invention is to provide a percussion tool wherein the operating means thereof may be operated but the tool will not be effective to deliver a blow until and unless the operating tool, such as a chisel, hammer or the like is pressed against the work.

Another object of the invention is to provide a percussion tool wherein the operating members thereof may be assembled readily from one end of the tool and thereafter positively held in working relation, with respect one to the other, by a single member completing the casing assembly, which member is readily and quickly secured to the casing.

Another object of the invention is to provide a percussion tool wherein a double cam is provided as actuating means for storing energy for delivering blows, wherein the cam is integral with the operating shaft and is so constructed and arranged therewith that it may be easily formed

with said shaft and the hammer and anvil of said shaft, such as by forging, coining, milling and the like.

Another object of the invention is to provide a percussion tool so constructed and arranged that the power storing means is operated by a double cam, permitting the maximum amount of power storing movement for a given diameter of tool, thus permitting a light, small, compact and efficient tool to be readily and inexpensively manufactured and assembled, and one which permits an operator to readily and easily operate said tool.

Another object of the invention is to provide a percussion tool wherein multiple cam rise assemblies are provided for increasing the travel of the blow delivering hammer of said tool.

Another object of the invention is to provide a percussion tool so constructed and arranged that a multiplicity of associated cams may be used around the circumference of the operating shaft for increasing the number of effective blows delivered by the hammer portion of said tool.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation as will be more fully described and particularly pointed out in the specification, drawings and claims appended hereto.

In the drawings, which illustrate embodiments of the device and wherein like reference characters are used to designate like parts—

Figure 1 is a longitudinal sectional elevation of one form of percussion tool embodying the invention;

Figure 2 is a longitudinal sectional elevation of a modified form of percussion tool embodying the invention;

Figure 3 is a fragmentary longitudinal sectional elevation through the striking end of another form of percussion tool embodying the invention, the same showing means for preventing operation of the percussion tool until and unless the cutting, chipping or other end is pressed against the work;

Figure 4 is an elevation of the sleeve of the tool illustrated in Figures 1, 2 and 3;

Figure 5 is a fragmentary sectional elevation through a modified form of sleeve, the same being taken substantially in the plane as indicated by the line 5—5 of Figure 6;

Figure 6 is a fragmentary top plan view of the sleeve illustrated in Figure 5;

Figure 7 is a longitudinal sectional elevation

of another modified form of percussion tool embodying the invention;

Figure 8 is a longitudinal sectional elevation of yet another modified form of percussion tool embodying the invention;

Figure 9 is a longitudinal sectional elevation of a different form of percussion tool embodying the invention;

Figure 10 is a longitudinal sectional elevation of a form of percussion tool embodying the invention wherein multiple rises are used;

Figure 11 is a fragmentary longitudinal sectional elevation through a form of percussion tool embodying the invention where another form of anti-friction members are used;

Figure 12 is a sectional elevation taken substantially in the plane as indicated by the line 12-12 of Figure 11;

Figure 13 is a fragmentary longitudinal sectional elevation of the striking end of a different form of percussion tool embodying the invention;

Figure 14 is a plan view of the shaft and cam of the percussion tool shown in Figure 13, the same looking toward the left toward the shaft end as viewed in Figure 13;

Figure 15 is a fragmentary longitudinal elevation of a modified form of cam for use in the percussion tools illustrated herein.

Referring first of all more particularly to the forms of tool end illustrated in Figures 1, 2 and 3, said ends consist essentially of a casing 20 provided with the shoulder or flange 22 adapted to be secured to the casing (not shown) of operating means such as a motor, the opposite end of the casing 20 being provided with securing means as the threads 24 adapted to have cooperative engagement with complementary threads provided on the tool nose 26. The nose 26 is generally tapering, but provided with shoulders (Figures 7, 8, 9, 11 and 13, which are 90° from Figure 1) for application of a wrench for assembly, and is provided with suitable air holes (similar to those shown at 182 in Figure 7). The nose 26 is also provided with the cylindrical bore or passage 28 for receiving a cutting, riveting or other tool, said bore 28 opening into the larger cylindrical bore 30 in which the sleeve bushing or bearing 32 is fixedly disposed.

The nose 26 also has a still larger bore 34 so disposed that a shoulder or track 36 is provided. The casing 20 is provided with the cylindrical bore 38 of smaller diameter than the bore 34 whereby the casing provides the shoulder 40. The wall 42 is provided adjacent the flange 22, said wall having the bore 44 in which the bearing or bushing 46 is disposed.

The operating shaft 48 is adapted to be non-rotatably secured as at 50 to a suitable coupling (not shown) whereby the shaft may be rotated by the operating means, the coupling permitting reciprocation of said shaft. The shaft extends through the bearing 46 and is provided with the enlarged hammer end 52 adapted to be journaled in the bearing 32. A cam member 54 is provided adjacent the hammer end, said cam being similar to that shown and described in United States Letters Patent No. 2,270,929, granted January 27, 1942, to Kenly C. Bugg, for Tool.

The cam member includes a double cam, the cams including the starting points 56 and 58 disposed adjacent the precipices 60 and 62, said precipices being preferably axially aligned. Each cam is then generated through 360° (a

substantially 3° slope being used for each cam shown), terminating at the precipices in the preferably rounded high points 64 and 66, the cams forming tracks 68 and 70 for the rotatable members, such as the balls 72 and 74. The diameter of each ball is slightly less than the depth of the adjacent precipice whereby no blow is taken by said balls when the shaft 48 is rotated. The ball 72 is adapted to engage the shoulder 36 whereby said shoulder forms a track for said ball, and, in the case of the construction shown in Figure 1, the ball 74 is adapted to roll over the track portion 76 of the reciprocating hammer member 78, said hammer member being recessed as at 80 and adapted to fit over and contact or deliver a blow to the enlarged hammer contacting or anvil portion 82 of the hammer end, and in effect constituting a prolongation of the hammer end 52 which may be considered as part thereof.

The balls are maintained in proper relative relation by means of the sleeve 84 (Figures 1, 2 and 4), said sleeve being provided with the short slot (which may be an aperture) 86, and the aligned elongated slot 88. The slot 86 serves as a guide for the ball 72, while the slot 88 serves as a guide for the ball 74. The sleeve is not fixed in the casing but is semi-floating, being positioned longitudinally by means of shoulders 40 and 36, but being free to rotate.

Between the hammer 78 and the wall 42 there is provided a spring casing or housing 90 (Figure 1), said spring casing including the casing or housing member 92 provided with the shoulder or flange 94 adapted to be engaged by the shoulder or flange 96 of the reciprocating casing or housing member 98. A spring 100 is disposed between the member 98 and the closure member 102 threaded as at 104 into the casing member 92. Thus a captive spring arrangement is provided.

A different form of captive spring arrangement is illustrated in Figure 2. In this construction the ball 74 is adapted to contact and rotate upon the hardened track member 106 through which the shaft 48 extends, the shaft being rotatable and reciprocal with respect to said track member. The hammer member 108 includes the casing member 110 and the end closure member 112 threaded thereto as at 114. This closure member engages the track member 106 and forms a spring seat for the spring 116. The other end of said spring engages the inner end of the casing member 118, said member 118 being provided with the flange 120 adapted to be disposed within the flange 122 of the member 110.

A modified form of sleeve member is illustrated in Figures 5 and 6 wherein the cylindrical sleeve member 124 is provided with an arcuate slot 126 extending longitudinally thereof for accommodating the balls such as the balls 72 and 74. In this case it will be noted that the balls do not extend through the shell of the sleeve as in the case of the sleeve illustrated in Figure 4.

In the construction illustrated in Figure 3, the cam member 54 is provided with a bore 128 in which the plunger 130 is reciprocally mounted, the bore 128 being adapted to be aligned with the aperture 132 provided in the sleeve 84. The plunger 130 is provided with the pilot 134 and the spring 136 is disposed between the plunger and the seat 138 formed in the cam member. The plunger 130 is slotted as at 140, one side of the slot being provided with the cam 142 adapted to contact the complementary cam 144 provided on

the control plunger 146. The control plunger 146 is reciprocally mounted in the axial bore 148 and is provided with the working tool engaging tip or projection 150. The plunger 146 is urged toward the right as viewed in Figure 3 by means of the spring 152 seated at one end on the plunger 146 and on the other end on the seat 154. When the casing 20 is pressed against the working tool, it being assumed that the tool is stationary, the tip 150 will move the plunger 146 toward the left as viewed in Figure 3, causing the cams 144 and 142 to move the locking plunger 130 upwardly as viewed in Figure 3, that is, to a position where the plunger 130 is disengaged from the aperture 132, thus permitting the cam to rotate independently of the sleeve 84, permitting operation of the percussion tool, as will be herein described more particularly. While a form of percussion tool (hammer) is shown similar to that illustrated in Figure 1, it is of course understood that this principle may equally well be applied to any of the other tools illustrated herein.

Referring now to the forms of percussion tools illustrated in Figures 7, 8 and 9, each of said tools include the casing 156 threaded as at 158 for the reception of complementary threads provided on the coupling, indicated generally at 160, for connecting the casing to the casing 162 of driving means such as a motor. The coupling 160 consists of the outer shell 164 threaded as at 166 to the motor casing 162, and said coupling includes the inner connecting member 168 threaded to the casing 156, the member 168 extending inwardly of the shell 164, filler means 170 of bab-bitt, rubber, etc., being disposed between the shell 164 and member 168 and a suitable washer 172 being disposed between the flange 174 of the member 168 and the end of the motor casing 162. The opposite end of the casing 156 is threaded as at 176 for the reception of complementary threads of the nose piece 178, said nose piece, generally tapered, being provided with the flattened portions 180 for reception of a suitable tool for application of the nose piece to the casing 156, it being seen that Figures 7, 8 and 9 are taken at substantially 90° from Figures 1, 2 and 3. Exhaust ports 182 extend through the nose piece, and each nose piece is provided with an axial bore 184 similar to the bore 28 for the reception of the work tool, said bore communicating with the larger bore 186 provided with the bearing sleeve 188. The bore 186 communicates with the larger bore 190 of the casing 156, the bore 190 being recessed as at 192 for the reception of the sleeve 194 similar to sleeves 84 or 124.

The rotatable shaft 196 is slidably connected as at 198 to the coupling 200 secured to the motor drive shaft 202, the shaft 196 extending through the bushing 204 provided in the end wall 206 of the casing 156. The shaft is provided with the enlarged anvil portion 208 adjacent the cam member 210. The cam member 210 is similar to the cam member 54 and the anvil 208 may be considered as part of the enlarged hammer portion 212 which is reciprocally mounted in the bearing 188. The cam member 210 is a double rise cam, being provided with the starting portions 214 and 216 sloping to the highest portions 218 and 220, preferably rounded, which are connected to the lowest portions 214 and 216 by means of the precipices 222 and 224. Balls 226 and 228, similar to the balls 72 and 74, are provided, the diameters of which are slightly less than the length of the precipices, the balls being guided by the sleeve 194 through the slots 230 and 232, it being

understood, however, that the sleeve shown in Figures 5 and 6 may also be used, as before pointed out. The ball 226 is adapted to roll on the hardened track member 234 provided in the nose piece.

In the construction illustrated in Figure 7, the ball 228 is adapted to roll on the track portion 236 provided on the hammer member 238, it being seen that when the hammer member drops or moves toward the right as viewed in Figure 7, it imparts a blow to the anvil portion 208, being moved toward the left as viewed in Figure 7 by the balls moving over the cams from the low to the high points, and being permitted to strike the blow when the balls fall down the precipices. A screw member 240 may extend through the casing 156 and be received in the slot 242 of the hammer 238 in order to prevent rotation thereof. The hammer member is provided with the spring seat 244, for one end of the spring 246, the other end being seated on the wall 206.

In the construction illustrated in Figure 8, the ball 228 rolls on the track portion 248 formed on the hammer member 250. The hammer member 250 is provided with the spaced guiding flanges 252 and 254 adapted to slide within the casing 156. A screw member similar to the member 240 may be or may not be provided, and the hammer member 250 is provided with the spring seat 256 for accommodating one end of the spring 258, the opposite end of said spring being seated on the wall 206.

In the construction illustrated in Figure 9, the ball 228 rolls on the track member 260 of the hammer member 262, said hammer member, as shown, being slotted as at 264 for the reception of one end of the screw member 266 for preventing rotation of the hammer member. In this case a captive spring arrangement is used wherein the spring 268 is seated at one end on the closure member 270 which engages the wall 206, the closure member being threaded or otherwise secured to the casing member 272. The casing member 272 is flanged as at 274, said flange being adapted to embrace flange 276 of the movable closure member 278 forming the opposite spring seat 280 for the spring 268.

In the percussion tool illustrated in Figure 10, a form of tool is shown wherein a plurality of double cam rises is utilized. This percussion tool consists essentially of the casing 282 provided with an end construction similar to that shown in Figures 1, 2, 7, 8 or 9 wherein a tool end is provided having means for associating the casing with the drive means casing (such as a motor casing), together with an end wall forming a spring seat. The casing 282 is provided with securing means such as the threaded portion 284 for association with the complementary threads of the nose 286, said nose being similar to that already described. The nose 286 is provided with the exhaust ports (not shown) and the work tool receiving bore 288, said bore communicating with the larger bore 290 in which the bearing bushing 292 is disposed.

The ball track 294 is provided on the nose and said track also serves as an abutment for the sleeve 296, said sleeve being preferably similar to that illustrated in Figures 5 and 6, though the slotted form may be used. The casing 282 is also provided with abutment means 298 so disposed that the sleeve is rotatably but non-reciprocally mounted in the casing. The operating shaft 300 extends through the housing 302 for the captive spring (not shown) which housing

abuts the hammer member 304. The hammer member is provided with the ball track 306 and is adapted to impart a blow to the enlarged anvil portion 308 provided on the cam 310. The cams 312 and 314 are also provided, similar in configuration to cam 310, and all of said cams are similar to cam 54. The cams 310, 312 and 314 are provided with the low spots 316, 318, 320, 322, 324 and 326 respectively, the cams being generated whereby the tracks extend to the high spots 328, 330, 332, 334, 336 and 338, respectively, said high spots being connected to the respective low spots by means of the precipices 340, 342, 344, 346, 348 and 350.

Rotatable members such as the balls 352, 354, 356, 358, 360 and 362 are adapted to rotate over the tracks of the respective cams and simultaneously to fall down the precipices being controlled by the sleeve 296. The track members 364 and 366 are provided between the respective cams, said track members being journaled on the anvil portions 368 and 370 respectively. The hammer and anvil portion 372 is journaled in the bearing 292, and adapted to impart a blow to the work tool. The track members 364 and 366 are provided with the flanges 374 and 376, respectively, forming tracks for the balls 354 and 356, and 358 and 360, respectively.

The cam 314 is fixed to the shaft 300. The cams 310 and 312 and track members 364 and 366 are feathered to said shaft whereby they are non-rotatable with respect thereto, but may reciprocate thereon. Then, when the balls are in the low spots of the cams, as after a blow has been given, rotation of the shaft will cause the balls to move around to the high spots, which will bodily move the cams 310 and 312 and the track members 364 and 366 toward the left as viewed in Figure 10, to the position illustrated in Figure 10, at the same time compressing the spring within the spring housing and moving the hammer member 304 to its fully raised position. Continued rotation of shaft 300 will cause the balls to fall down their respective precipices, whereupon the sleeve will cause the hammer member 304 to be moved toward the right as viewed in Figure 10, causing a blow to be delivered to the anvil, which in turn is imparted to the work tool, said balls falling simultaneously by action of the sleeve.

In the construction shown in Figures 11 and 12, the casing 378 is threaded as at 380 to the nose 382 (similar to the nose 54), said nose being provided with suitable exhaust openings 384. The work tool bore 386 communicates with the larger bore 387 in which the bearing sleeve 388 is disposed. The hammer member 389 is adapted to move toward the right by a spring (not shown) and impart a blow by engagement with the anvil 390 provided on the rotatable shaft 392, the blow being delivered to the work tool by the hammer 393 which is part of the anvil. As before, the shaft is provided with the cam 394 generally similar to cam 54, with the exception, however, that the track portions 396 and 398 have the same slope as the tapered rollers 400 and 402, the inner ends of the rollers being preferably arcuate as at 404 and 406. The outer enlarged ends 408 and 410 of the rollers are also arcuate, and said rollers are provided with the outwardly extending cylindrical guides 412 and 414 receivable in slots 416 and 418 provided in the sleeve 420. The rotatable sleeve 420 is fixed against longitudinal movement by the shoulder 422 provided on the casing 378, and the roller track 424 provided on

the nose 382, and the enlarged hammer end 393 of the anvil portion is journaled within the bearing 388. The operation of this form of device is of course similar to that of the other herein described constructions.

In the construction shown in Figures 13 and 14, the casing 428 is provided with the threaded end 430 adapted to receive the nose 432, similar to the nose 26, being provided with the exhaust openings 434 and the tool receiving bore 436. The tool receiving bore 436 communicates with the larger bore 438 provided with the bearing sleeve 440. The hammer member 442 is adapted to deliver a blow by means of a spring (not shown) to the enlarged anvil portion 444 of the shaft 446, and the hammer end 448 of the anvil portion is journaled in the bearing 440. The cam member 450 provided on said shaft is provided with oppositely facing cam rises, each cam rise comprising a plurality (shown two) of cam tracks having low points 452, 454 and 456, 458, and extending to high points 460, 462 and 464, 466, respectively. The rotatable members such as the balls 468 and 470 are provided (though four balls may be used) it being seen that two drops are provided for each revolution.

In the operation of the forms of tool shown, it will be seen that rotation of the shafts rotates the cams, causing the balls to pass from the low point to the high point of the cams, compressing the spring and moving the hammer member to raised position. When the balls fall down the precipices the spring is permitted to move the hammer to impart a blow to the anvil, which blow is imparted to the work tool through the hammer of the anvil. The balls rotate over the tracks at substantially the same time and fall at exactly the same time whereby the maximum blow is delivered and no blow is taken on said balls.

In the case of the tool illustrated in Figure 3, it is necessary to press the tool against the work, moving the work tool toward the left as viewed in said figure, whereupon the member 146 moves against the spring 152, causing the cams 144 and 142 to move the locking member 130 out of engagement with the aperture 132, whereupon the sleeve does not move with the cams and consequently can guide the balls so that they will move over the cams and down the precipices.

It has further been found desirable to round the high points of the cams slightly in order to prevent undue stresses at those points, but substantially the same effect can be acquired by forming the cams as shown in Figure 15. In that figure, the shaft 472 is provided with the anvil 474, said anvil having the hammer end 476 for imparting a blow to the work tool. The cam member 478, which is of double cam construction, is provided with the substantially rounded lower points 480 and 482 which slope to the rounded highest points 484 and 486, providing tracks 488 and 490 for the rotatable members (shown in other figures as balls or rollers). The highest and lower points are connected by the sloping precipices 492 and 494 which are preferably formed so that the projection of said slope shown between the arrows 496 is not more than the radius of one of the rotatable members. The operation of a tool using this construction is of course similar to that already described.

It is to be understood that I do not wish to be limited by the exact embodiments of the device shown, which are merely by way of illustration and not limitation, as various and other forms of

the device will of course be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

I claim:

1. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for reciprocating said shaft, means for rotating said shaft, said shaft having an anvil portion adapted to engage a work tool, a hammer member movable with respect to said shaft by said first named means, and adapted to deliver a blow to said anvil portion whereby a blow is delivered to said tool and resilient means alternately compressed and released by said first named means for urging said hammer member toward said anvil portion whereby a blow is delivered by said hammer member to said anvil portion.

2. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for reciprocating said shaft, means for rotating said shaft, said shaft having an anvil portion adapted to engage a work tool, a hammer member movable with respect to said shaft by said first named means, resilient means for urging said hammer member toward said anvil portion, said resilient means having a housing, said housing including a housing member substantially relatively fixed with respect to said casing, and a member movable with respect to said housing member and engaging said anvil portion.

3. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for reciprocating said shaft, means for rotating said shaft, said shaft having an anvil portion adapted to engage a work tool, a hammer member movable with respect to said shaft by said first named means, and resilient means in said hammer member for urging said hammer member toward said anvil portion.

4. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for reciprocating said shaft, means for rotating said shaft, said shaft having an anvil portion adapted to engage a work tool, a hammer member movable with respect to said shaft by said first named means, resilient means for urging said hammer member toward said anvil portion, and means for selectively preventing operation of said first named means.

5. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, said shaft having an anvil portion and a work tool striking portion, said casing being adapted to accommodate a work tool, means for rotating said shaft, means for reciprocating said shaft when said shaft is rotated to cause said striking portion to deliver a blow to said work tool, a hammer member adapted to deliver a blow to said anvil portion, said hammer member being movable by said second named means away from said anvil portion, and resilient means for moving said hammer member into engagement with said anvil portion to deliver a blow thereto.

6. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for reciprocating said shaft, means for rotating said shaft, said shaft having an anvil portion adapted to engage a work tool, a hammer member movable with respect to said shaft by said first named means, and resilient means extending into said hammer member and alternately compressed and released by said

first-named means for urging said hammer member toward said anvil portion whereby a blow is delivered by said hammer member to said anvil portion.

7. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, rotatable members movable over said cams, a hammer member movable by said rotatable members, resilient means urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, and an anvil on said shaft engageable by said hammer member.

8. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, a roller movable over each of said cams, a hammer member movable by said rollers, resilient means urging said hammer member toward said rollers, means for causing said rollers to move over said cams in a predetermined manner, and an anvil engageable by said hammer member.

9. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including pairs of oppositely facing cams, rotatable members movable over said cams, a hammer member movable by said rotatable members, resilient means urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, and an anvil on said shaft engageable by said hammer member.

10. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including pairs of oppositely facing cams, rotatable members movable over said cams, a hammer member movable by said rotatable members, resilient means urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, and an anvil engageable by said hammer member.

11. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, each cam comprising a low point and a high point, a track extending from said low point to said high point and a precipice connecting said high and low points, a ball movable over each of said cams in such a manner that it moves from said low point to said high point and down said precipice to said low point, the length of the projection of the slope of the precipice on a plane perpendicular to the axis of the shaft being not over the length of the radius of the balls, a hammer member movable by said balls, resilient means urging said hammer member toward said balls, means for causing said balls to move over said cams in a predetermined manner, and an anvil on said shaft engageable by said hammer member.

12. In a percussion tool, the combination of

a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, each cam comprising a low point and a high point, a track extending from said low point to said high point and a precipice connecting said high and low points, a ball movable over each of said cams in such a manner that it moves from said low point to said high point and down said precipice to said low point, the length of the projection of the slope of the precipice on a plane perpendicular to the axis of the shaft being not over the length of the radius of the balls, a hammer member movable by said balls, resilient means urging said hammer member toward said balls, means for causing said balls to move over said cams in a predetermined manner, and an anvil engageable by said hammer member.

13. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including spaced cam means, each of said cam means including oppositely facing cams, track means between each cam means, certain of said cam means and said track means being slidably but non-rotatably mounted on said shaft, a ball movable over each of said cams, certain of said balls engaging said track means, a hammer member movable by said balls, resilient means urging said hammer member toward said balls, means for causing said balls to move in a predetermined manner, and an anvil on said shaft engageable by said hammer member.

14. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including spaced cam means, each of said cam means including oppositely facing cams, track means between each cam means, certain of said cam means and said track means being slidably but non-rotatably mounted on said shaft, a ball movable over each of said cams, certain of said balls engaging said track means, a hammer member movable by said balls, resilient means urging said hammer member toward said balls, means for causing said balls to move in a predetermined manner, and an anvil engageable by said hammer member.

15. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, rotatable members movable over said cams, a non-rotatable hammer member movable by said rotatable members, housed resilient means urging said hammer member toward said rotatable members, the housing of said resilient means including a housing member relatively fixed with respect to said casing and a relatively movable housing member engaging said hammer member, means for causing said rotatable members to move over said cams in a predetermined manner, and an anvil on said shaft engageable by said hammer member.

16. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said

last named means including oppositely facing cams, rotatable members movable over said cams, a rotatable hammer member movable by said rotatable members, housed resilient means urging said hammer member toward said rotatable members, the housing of said resilient means including a housing member relatively fixed with respect to said casing and a relatively movable housing member engaging said hammer member, means for causing said rotatable members to move over said cams in a predetermined manner, and an anvil on said shaft engageable by said hammer member.

17. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, rotatable members movable over said cams, a rotatable hammer member movable by said rotatable members, resilient means extending into said hammer member and urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, and an anvil on said shaft engageable by said hammer member.

18. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, rotatable members movable over said cams, a non-rotatable hammer member movable by said rotatable members, resilient means extending into said hammer member and urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, and an anvil on said shaft engageable by said hammer member.

19. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, rotatable members movable over said cams, a hammer member movable by said rotatable members, resilient means urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, and an anvil on said shaft engageable by said hammer member, said last named means comprising a floating sleeve having an arcuate groove extending for substantially the length of said sleeve and on the inside thereof.

20. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, rotatable members movable over said cams, a hammer member movable by said rotatable members, resilient means urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, and an anvil on said shaft engageable by said hammer member, said last named means comprising a floating sleeve having a long slot and a shorter slot into which said rotatable members respectively extend.

21. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said

tion in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, a rotatable member movable over each of said cams, a hammer member movable by said rotatable members, resilient means urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, an anvil engageable by said hammer member for receiving a blow therefrom, said last named means including a floating sleeve, and means carried by said shaft for causing said sleeve to rotate with said shaft thereby preventing said hammer member from delivering a blow to said anvil.

22. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, a rotatable member movable over each of said cams, a hammer member movable by said rotatable members, resilient means urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, an anvil engageable by said hammer member for receiving a blow therefrom, said last named

means including a floating sleeve, a locking member mounted transversely of said shaft and adapted to engage said sleeve to cause said sleeve to rotate with said shaft thereby preventing said hammer member delivering a blow to said anvil, and a control member mounted longitudinally of said shaft movable to cause said locking member to release said sleeve.

23. In a percussion tool, the combination of a casing, a rotatable shaft mounted for reciprocation in said casing, means for rotating said shaft, means for reciprocating said shaft, said last named means including oppositely facing cams, a rotatable member movable over each of said cams, a hammer member movable by said rotatable members, resilient means urging said hammer member toward said rotatable members, means for causing said rotatable members to move over said cams in a predetermined manner, an anvil engageable by said hammer member for receiving a blow therefrom, said last named means including a floating sleeve, a locking member adapted to cause said sleeve to rotate with said shaft thereby preventing said hammer member delivering a blow to said anvil, and a control member movable to cause said locking member to release said sleeve.

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