May 22, 1934. J. N. BAKER 1,959,516

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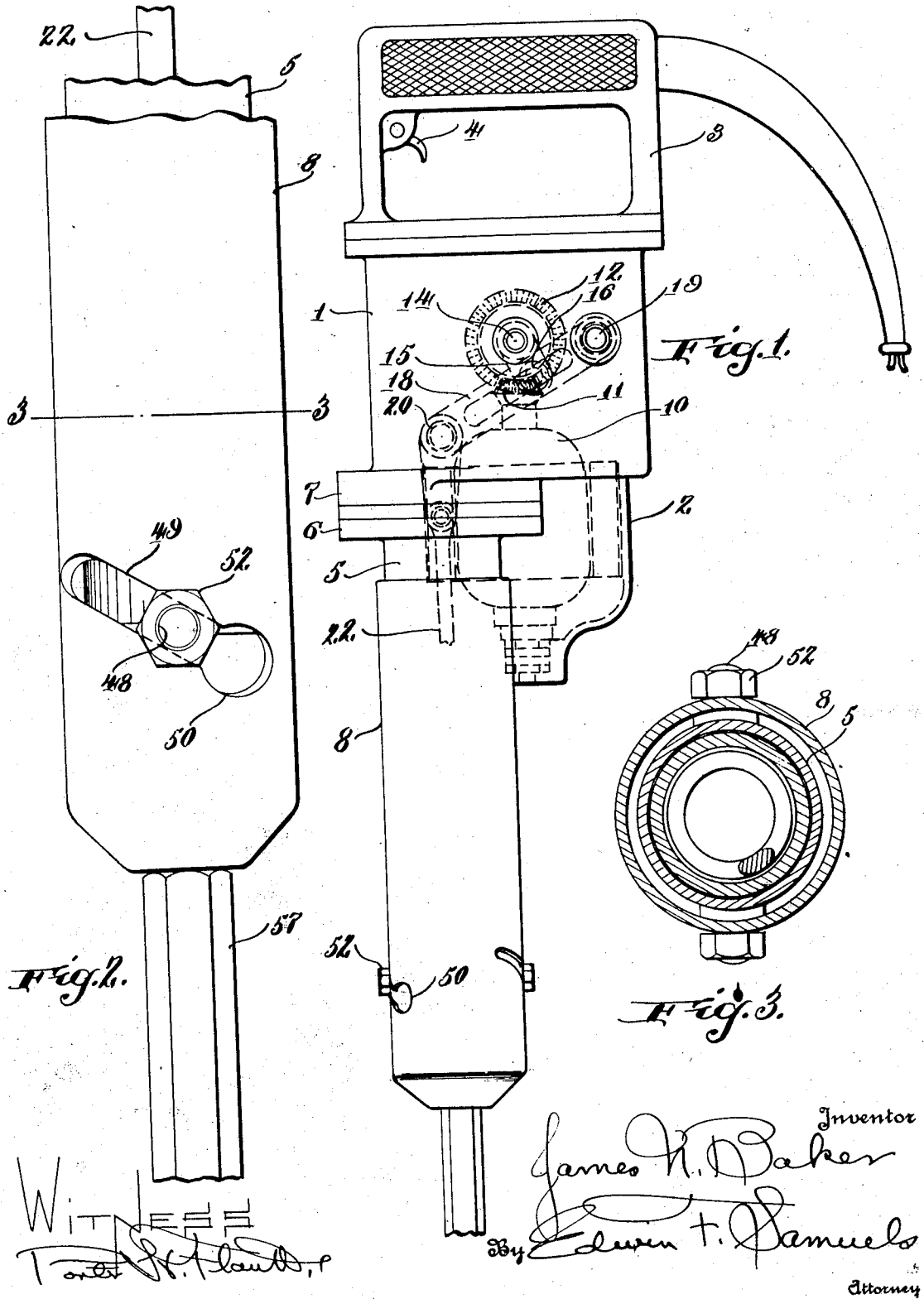


Fig. 1.

Fig. 2.

Fig. 3.

Witness

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May 22, 1934. J. N. BAKER 1,959,516

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Filed Aug. 28, 1930 5 Sheets-Sheet 2

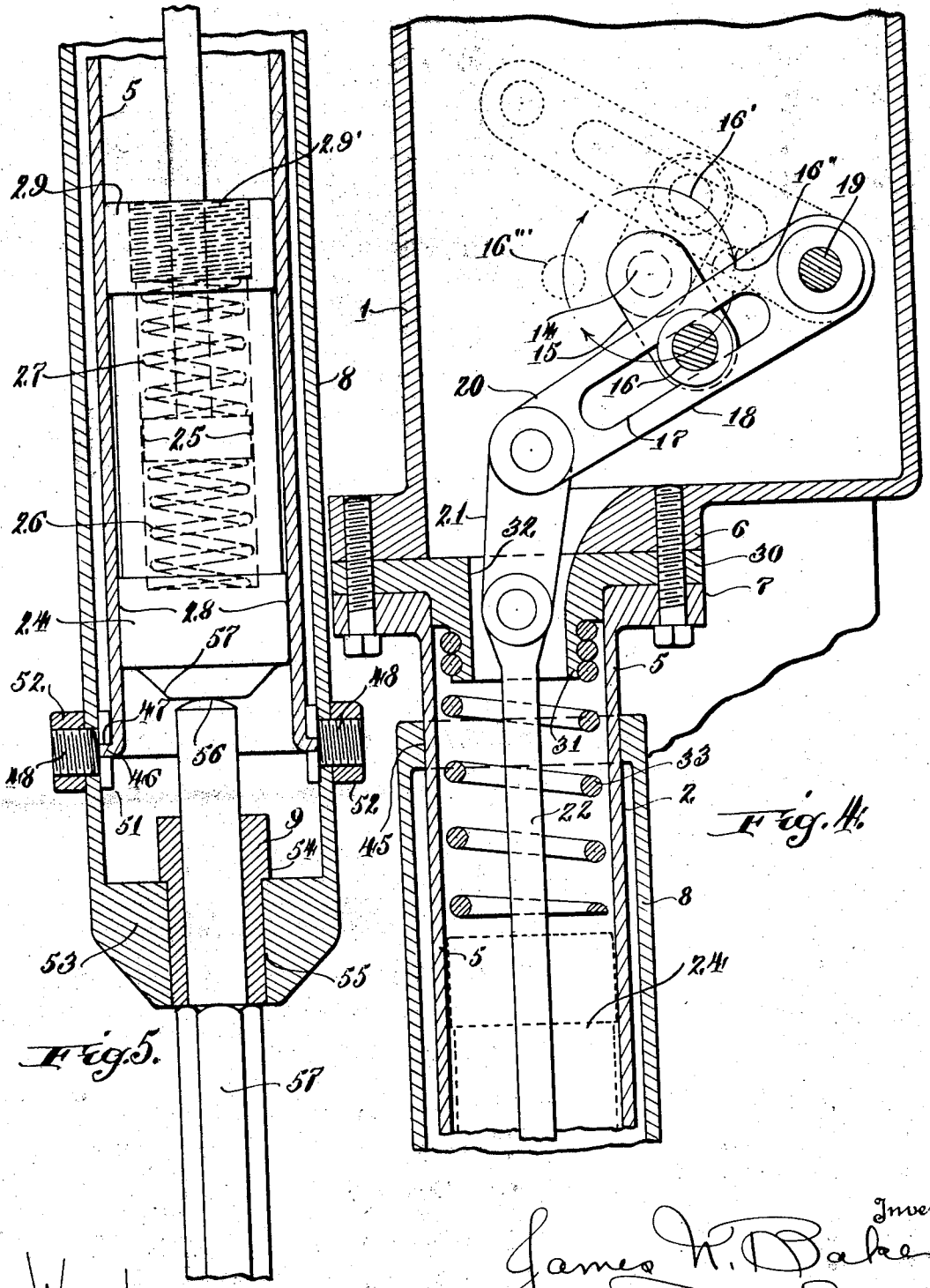


Fig. 5.

Fig. 4.

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Filed Aug. 28, 1930 5 Sheets-Sheet 3

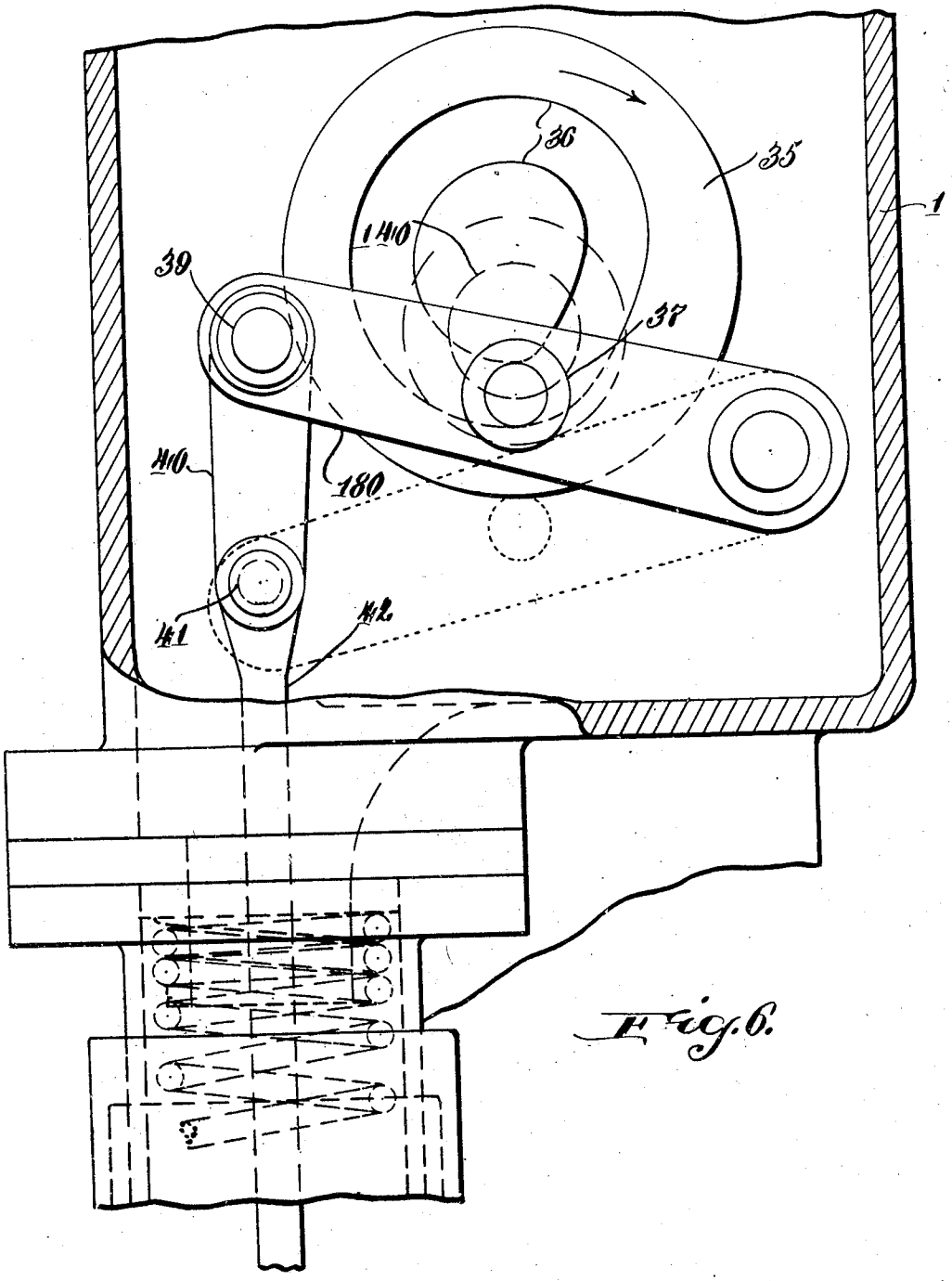


Fig. 6.

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Filed Aug. 28, 1930 5 Sheets-Sheet 4

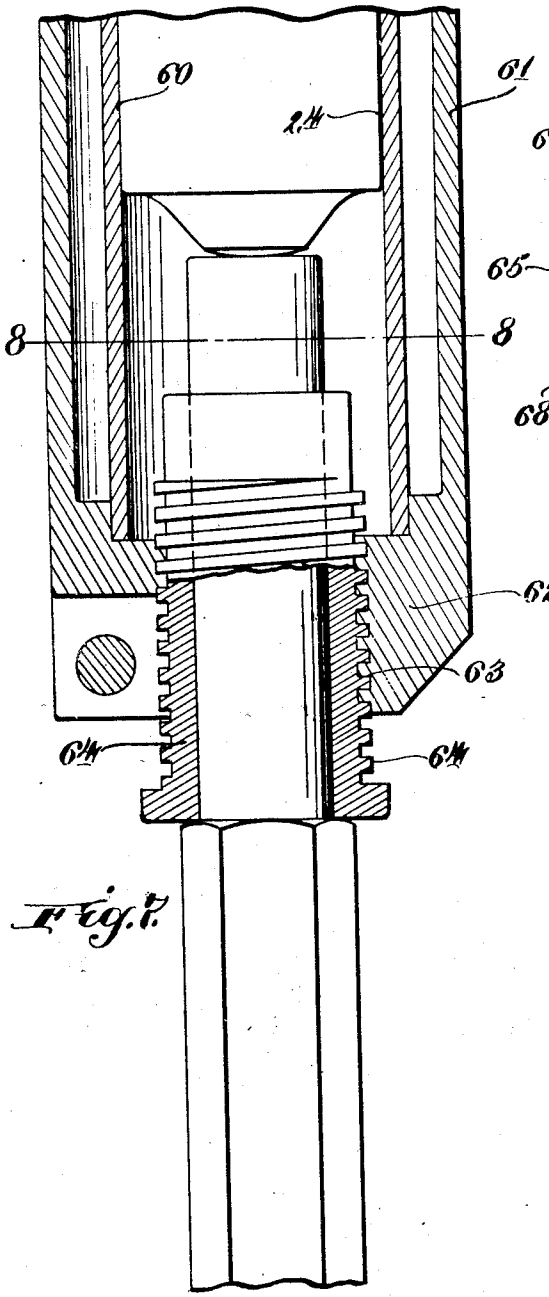


Fig. 7.

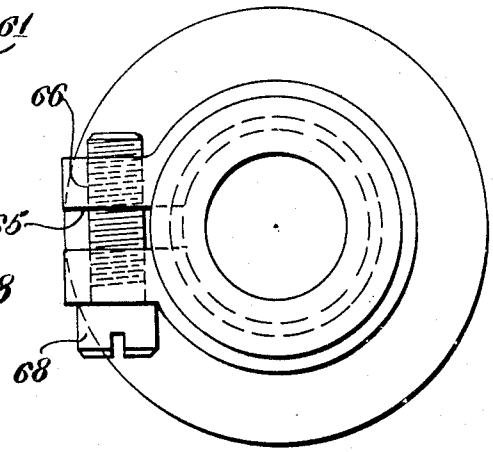


Fig. 9.

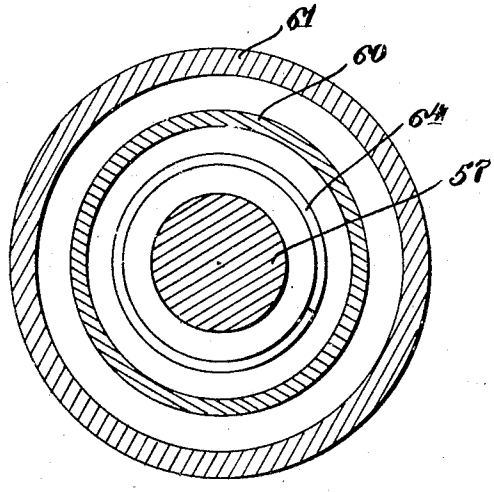


Fig. 8.

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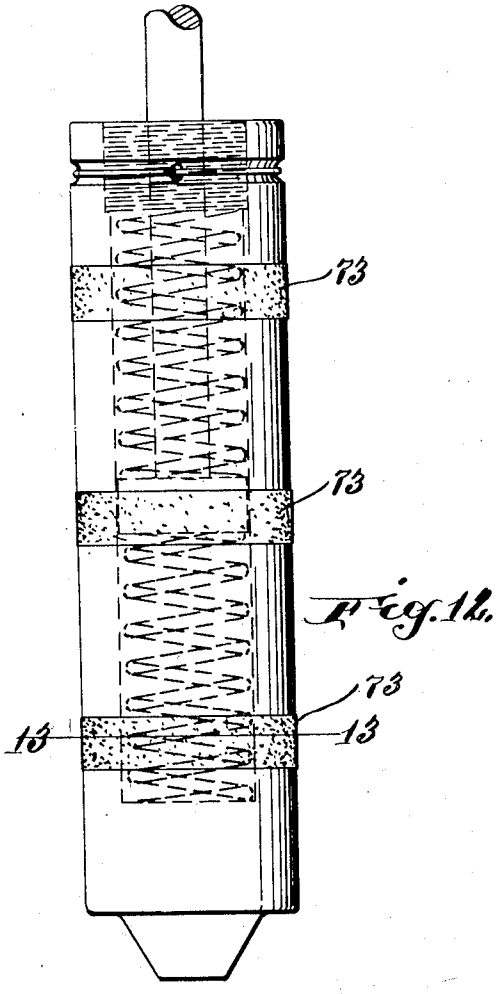


Fig. 12.

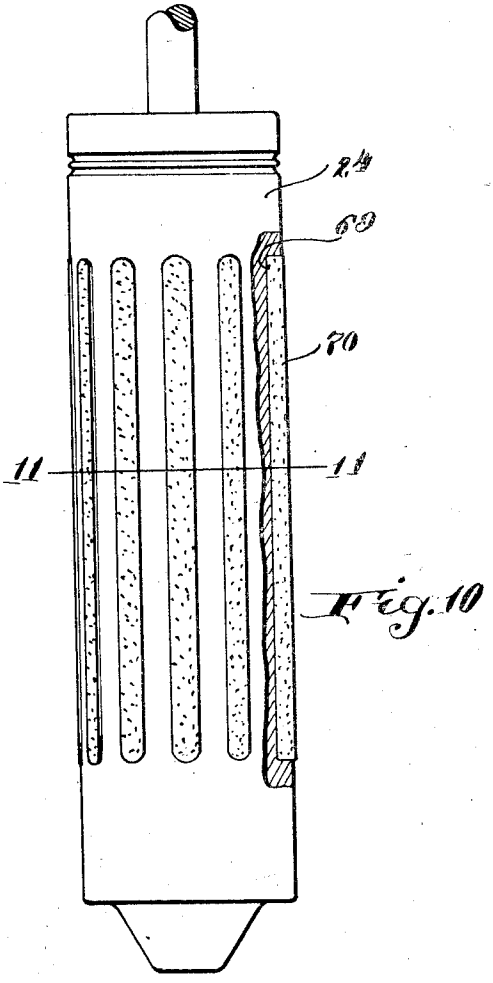


Fig. 10

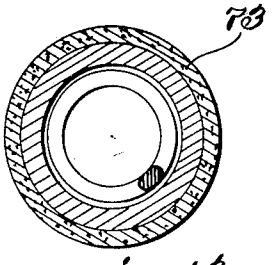


Fig. 13.

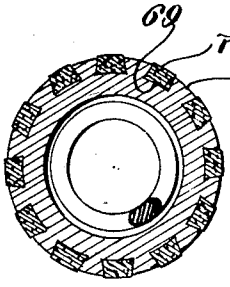


Fig. 11.

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UNITED STATES PATENT OFFICE

1,959,516

HAMMER

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Application August 28, 1930, Serial No. 478,495

7 Claims. (Cl. 125—33)

The invention relates to portable power driven hammers of the type which have a reciprocating ram, the reciprocating motion being obtained from a rotary actuating member, ordinarily an electric motor. The rotary motion thus transformed into a reciprocating motion is communicated to the ram by means of a plunger or piston to which the reciprocating motion from the crank or other means for converting rotary into reciprocating motion is communicated. The plunger or piston being mounted between two springs which are normally compressed between the plunger and corresponding opposite abutments on the ram, a vibratory motion being thus transmitted from the source of rotation through the piston and springs to the ram.

A suitable reciprocating motion being communicated to the piston or plunger, a vibratory motion is imparted by the springs to the ram, the periodicy of which vibratory motion is determined by and is a function of the rotative speed of the crank or other corresponding shaft the resulting stroke of plunger, the relative values of the springs and the mass of the ram, it being understood that the unit comprising the springs and ram has a natural period of vibration or oscillation based on the proportions of the springs to each other and to the mass of the ram and the speed of rotation of the crank shaft.

In the present instance, this natural period of vibration is in the preferred form of the hammer an integral factor of the speed of rotation of the crank so that there are one or two or more complete revolutions of the crank or other actuating member for each stroke or blow of the ram whereby a movement of the ram is obtained which is far in excess of that obtained from the crank alone.

As a concrete example of an apparatus embodying the invention in operative form, the crank or other corresponding shaft may have a normal speed of from 1,800 to 2,000 revolutions. This rotative motion may be obtained from any source. If an electric motor is employed, a motor operating at about 12,000 R. P. M. will be found satisfactory, it being understood that these figures are merely illustrative, being capable of wide variation. Under these circumstances, the speed of the ram would where there are two complete revolutions to each blow, be 900 to 1,000 strokes per minute, but the timing and the strokes may be widely varied within the scope of the invention, as already pointed out, and further, the ram and springs may be so proportioned and the natural period of vibration of the ram so determined as to give one or more revolutions of the crank to each stroke of the ram.

By thus designing and proportioning the apparatus the speed of the ram being a function of the tension and relative strength of the springs, the mass of the ram and the length of the stroke, the springs themselves become a part of the actuating means whereby the motion of the crank, the momentum of the ram and the tension of the springs are combined to produce the vibration or stroke of the ram, giving an operation and a function of the springs entirely different from that which they serve in the relatively slow motion hammers in which they act merely as a cushioning means.

In the form of the hammer illustrated a bit for applying the impact of the ram to the work is so located as to interrupt the motion of the ram at the proper point and the impact of the ram is thus utilized in chipping steel, driving rivets, cutting or drilling concrete or stone or for any other purpose for which a high speed power operated hammer is employed.

In the use of this type of tool it has been found that under various circumstances it is desirable to increase the length of the stroke of the ram resulting from a crank of a given radius. It is also found desirable to so control the ram by the manner of transmitting the motion of the crank thereto that its velocity is greater in one direction than in the other. It has also been found in the operation of these tools that the position of the head of the cutting tool, i. e., the end of the shank which receives the hammer blow in its relation to the path of the ram or more particularly the relation of the head of the cutting tool to a point determined by the position of the nose of the ram at the end of the downward or working stroke when the hammer is running idle determines to a great extent the impact as well as the speed of the blow delivered. It has also been ascertained that a certain type and speed of blow may be more suitable when working on soft materials whereas different characteristics of the blow are desirable when working on hard materials. To meet the conditions thus described, the hammer is equipped as hereinafter described with means for adjusting the position of the head of the cutting tool or bit in the direction of the stroke and relatively to the path of the ram and/or relatively to the barrel so as to provide in turn for the variation in the speed and character of the blow as already pointed out.

Having further reference to the operation of the above described type of hammer, it will be

noted that while any tendency to overtravel of the ram at the completion of the downward stroke of the piston is arrested by the cutting tool, the motion of the ram on the rear or upward stroke is free and the overtravel of the ram beyond the position corresponding to the retracted position of the plunger due to the momentum of the ram is arrested only by the compression of the front or lower spring.

It has been found that the insertion of a relief spring properly designed as to length, and natural vibration period, will arrest this overtravel and relieve the front or lower ram spring, at the same time giving the hammer increased power on the working stroke and the invention further relates to the provision of such a spring in combination with the ram actuating means and particularly the balanced springs as hereinafter described.

A further feature of the invention relates to the provision of bearing means for the ram as it reciprocates in the barrel, the same being of wood or equivalent material having a self lubricating function whereby the binding and excessive wear of the guiding and bearing surfaces is prevented.

In the accompanying drawings I have illustrated a hammer of the type referred to, embodying the various features of the invention in the preferred and in some instances in an alternative form.

In the drawings:

Figure 1 is a side elevation of the assembled hammer.

Figure 2 is a fragmentary elevation from the same point of view showing the adjustable tool supporting tube or tubular casing.

Figure 3 is a horizontal section on the line 3, 3, in Figure 2.

Figure 4 is a vertical central section parallel to the plane of Figure 1 showing the crank and lever means for actuating the ram, and also the relief spring.

Figure 5 is a section on the line 5, 5 in Figure 4 showing the lower end of the tubular casing, the barrel and the tool bushing.

Figure 6 is a section corresponding to Figure 4 showing a cam and lever actuating means in place of the crank and lever actuating means, the lower portion of the figure, i. e., the fragment of the barrel, etc. being in elevation instead of in section.

Figure 7 is a section corresponding to the section Figure 5, showing a modified construction for adjusting the position of the tool bushing relatively to the ram path and barrel.

Figure 8 is a horizontal section on the line 8, 8 in Figure 5.

Figure 9 is a bottom plan of the construction shown in Figure 7.

Figure 10 is an external elevation of the ram removed, the same being provided with soft lubricating inserts extending in the direction of the stroke.

Figure 11 is a section in the line 11, 11, in Figure 10.

Figure 12 is an elevation of the ram having circumferential inserts of soft lubricating materials as wood.

Figure 13 is a section on the line 13, 13 in Figure 12.

Referring to the drawings by numerals, each of which is used to indicate the same or similar parts in the different figures, the portable power driven hammer as shown comprises as to the external portions shown particularly in Figure 1, a gear casing 1, motor housing 2, and grip 3, having a switch control trigger 4 and barrel 5 for the ram.

The barrel is flanged at its upper end at 6, which flange is secured to a corresponding flange 7 on the gear casing. Mounted on the barrel 5 is an external tubular casing member 8, otherwise referred to as a tool or bit supporting tube, in the lower end of which the tool bushing 9 is mounted, see particularly Figure 5.

Figure 1 also includes an electric motor 10 shown in dotted lines. This motor carries mounted on the motor shaft a bevel pinion 11 which meshes with a larger bevel gear 12, on a transverse shaft 14, which, in this instance, is a crank shaft to which is secured in this construction a crank 15 which, as seen in Figures 1 and 4, is adapted to rotate clockwise, i. e., in a right-handed direction. This crank 15 carries a crank pin 16, which engages a longitudinal slot 17 in the rocking lever 18 pivotally mounted in the gear casing at the right of said crank shaft 14 as seen in Figure 1 and 4, said pivot point or journal being indicated by reference character 19. The swinging end 20 of the rocking lever 18 is connected by any suitable means as connecting rod 21 to the thrust rod or piston rod 22, which operates the ram 24, being connected at its lower end and secured to a suitable plunger or piston 25, which is mounted between normally compressed balanced helical springs 26 and 27, Figure 5, whereby it is supported between suitable abutments 28, 29 on the ram between which the springs 26 and 27 are compressed and against which the outer or opposite ends of said springs bear. The ram 24 is in turn mounted to slide and to reciprocate in the barrel 5 already described. The flanges 6, 7 at the upper end of the ram and on the casing 1, support between them an abutment plate 30, which carries a downwardly projecting boss 31 which surrounds an opening 32 between and connecting the gear casing 1 and the barrel 5 in and through which the connecting rod 21 and the piston rod 22 operate. This boss 31 serves as the upper seat for a helical spring 33 which encircles the boss at its upper end and bears at its lower end against the upper end of the ram 24. This spring is referred to herein as a relief spring, adapted to arrest the tendency of the ram to overtravel on its upward or return stroke, relieving the strain on the front or lower ram spring, increasing the output of work in the form of blows delivered to the tool or bit.

It is not material whether this spring bears directly on the ram or is merely located in the path of the ram as shown in Figure 4. Its effect in modifying the motion of the ram, checking the motion of the ram on the non-working or upstroke relieving the balanced spring on the opposite side of the plunger and increasing the force of the blow would be the same. As will be evidenced in the foregoing, this spring operates in combination with the balanced springs 26, 27 to determine the result of the stroke of the ram, which stroke is also affected to a considerable extent by the position of the tool, which latter is adjustable and varies the stroke of the ram as hereinafter described.

Figure 6 shows a ram actuating mechanism which is alternative to, i. e., a substitute for the crank 15 and slotted lever 17, 18. In accordance with this construction the shaft 140 which corresponds to the shaft 14 in Figure 4, carries a path cam 35 secured thereto and having a path 36 of a predetermined or any desired throw, engaged by a follower 37, which follower is secured to a

rocking lever 180 pivotally mounted at one end on the gear casing 1, which serves as a frame and being pivotally connected at its opposite, swinging end at 39 to a connecting rod 40 which at its opposite end is pivotally connected at 41 to a piston rod or thrust rod 42 corresponding to the piston rod 22, Figures 1 and 4, and similarly connected to the ram 24. It is evident that the length of the hammer stroke is increased relatively to the throw of the cam by means of the lever 180 and that the length of the stroke will be regulated by changing the length of this rocking lever 180 or substituting a different lever of a different length and the relative velocities of the working and the return strokes may be regulated by the shape of the cam track 36, which change of the cam track being effected by substituting different cams.

Regarding the construction of Figures 1 and 4, it will be noted that during the down or working stroke the crank pin 16 moves downwardly through the arc 16', 16'', 16''' indicating the different positions of the crank pin 16, and that on the return stroke it moves through the arc 16, 16''', 16', so that the relative working and return velocities of the hammer will be in inverse proportion of these arcs. Also, the length of the stroke and the velocity of the ram can be changed without changing the speed of the motor or the length of the crank by substituting a rocking lever arm 18 of a different length.

As already pointed out, it has been found from practical experience with percussive tools of the balanced spring plunger type herein described, that the position of the head of the cutting tool or bit with relation to the path of the ram or more particularly with relation to the nose of the ram at the end of the downward stroke when running idle, determines to a great extent the character as well as the speed of the blow and that a variation as to the character and speed of the blow is desirable when working on different materials, the soft materials requiring a different character of blow from that required by the harder materials.

To effect this result, the applicant has provided means for changing the position of the tool bushing relatively to the path of the ram, such a device being illustrated in Figures 1 to 5, and a modified form of the same in Figures 7, 8 and 9.

In accordance with the construction shown in Figures 1 to 5, the tool bushing 9 is supported by and on the lower end of the tubular casing or sleeve 8, which encloses the barrel 5 and slides thereon for purposes of adjustment in the direction of the stroke, being provided in the form of the invention with a sliding bearing 45, Figure 4, at its upper end which encircles and engages the barrel guiding the tubular casing 8 as it slides thereon. The barrel, in turn, is provided at its lower edge with an outwardly disposed flange 46 of slightly less diameter than the inside of the tubular member 8. In the form of the invention shown in Figures 1 to 5, this flange is received and forced under pressure into the slots 47 in screws 48 which extend laterally through the walls of the tube 8 near the bottom, being mounted in helical slots 49 in the tubular casing, see Figure 2. These slots 48 are shown as enlarged at their lower ends at 50 to pass the slotted heads 51 and said screws 48, which are held in position in said slots 49 by nuts 52, engaging the outer ends of the screws and bearing against the outer surface of the tube 8. The outer sleeve or tubular casing 8 is provided at its lower end with a suitable closure 53 which is preferably thickened as shown and bored at 55 to receive the tool bushing 9 which is shouldered at its upper end at 54 to position the tool bushing 9 in the opening 55, in which it fits closely so as not to be easily displaced.

It will be understood that the nuts 52 being loosened, permit the rotation of the sleeve or tubular casing 8 relatively to the barrel 5, the flange 46 being secured in the slots 47 in the heads of the screws in any suitable manner as by forcing the screws inwardly under pressure causing the flange 46 to enter slots 47, the screws 48 will move along the helical slots 49 moving the casing 8 in the direction of the barrel axis, and of the motion of the ram, changing the position of the tool bushing and of the upper end 56 of the tool or bit 57 relatively to the path of the ram or more particularly to the position of the nose 57 of the ram in what may by termed its lowermost position 1. When the desired adjustment of the position of the tool bushing or bit head relatively to the path of the ram has been determined the nuts 52 may be tightened to hold the desired adjustment. While in the present instance the ram comes in direct contact with the end of the tool shank it will be appreciated that this member has the function of an anvil or blow transmitting member, which might be interposed between the ram and the tool so that the upper end of the tool which receives the blow is referred to herein as an anvil or impact receiving member.

Figures 7, 8 and 9 show a ram barrel 60 having an outer sleeve 61 which is stationary, the barrel being suitably secured as by welding or sweating at its lower end to the bottom closure 62 of the sleeve or tubular casing 61. This bottom closure is thickened as shown and bored and threaded at 63 to receive a threaded tool bushing 64 and to hold the tool bushing in the desired position of adjustment the lower end of the sleeve or tubular member 61 is preferably slotted radially at 65 and provided with a threaded hole 66 crossing the slot at right angles and adapted to receive a screw 68 whereby the tool bushing 64 may be clamped in any desired position.

The screws 68 being loosened, the bushing 64 is moved up or down by rotating it, operating the screw threads, 63. When it has reached the desired position of adjustment, it is clamped by tightening the screw 68.

Still another feature of the invention consists in the provision of self lubricating means preferably on the ram whereby the tendency to cut and wear the barrel and to become cramped therein is overcome. To this end the ram 24, Figure 10 is slotted longitudinally as to its external surface at 69 and correspondingly shaped strips of wood or similar self lubricating material 70 are forced into the slots and so placed as to protrude to a slight degree as shown whereby they are caused to bear against the inner surface of the barrel giving the desired antifrictional or self lubricating effect and supporting the ram in the barrel in its reciprocating relation thereto in a slightly yielding manner preventing the tendency of the ram to cramp, cut and wear the barrel.

Figure 12 shows self lubricating bearing members 73 spaced apart in the direction of the length of the ram and arranged circumferentially thereof, to give a complete circle of contact of the ram with the barrel and by the longitudinal spacing to maintain the alignment.

In the construction of applicant's tool, as described, it is regarded as an essential feature that the values and/or relative values of the springs 26, 27 as compared to the mass of the ram 24 be so selected that the ram has a natural period of vibration or oscillation which is equal to or an integral factor of the speed of rotation of the crank, i. e., the speed of the crank or other transverse driving shaft 14 or 140, and is a multiple of the natural speed of vibration of the ram. Preferably the ram makes a single oscillation or stroke after each two or more complete revolutions of the crank, but these elements may be so selected as to give a stroke of the ram for each revolution of the crank or cam shaft. The selection of a speed of the ram suitable to the natural period of vibration of the ram assembly is an important element in the practice of the invention, the cushioning effect of the springs being of secondary importance. In this way movement or speed of the ram becomes much greater than that of the piston. The action of the crank or cam and springs in applying the torque of the motor to the ram and converting it into the momentum of the ram being cumulative, resulting in the maximum impact in proportion to the weight of the tool to the size of the motor and the power.

The rocking levers 18, 180 provide means for increasing the length of the stroke with the same crank radius or cam throw and by means of the crank 15 combined with this arm the relative velocities of the work and the return strokes and high velocity thereof. A somewhat similar result is accomplished by means of the path cam 35, which provides any desired velocity relation between the forward and return strokes as described or otherwise. As shown, it confines the stroke of the ram to a relatively small arc of revolution, the ram being stationary for the remainder of the revolution. The consequent quick vibration of the plunger transmits a corresponding impulse to the spring which produces an intensely high speed hammer blow.

The effect of changing the position of the cutting tool relatively to the path of the ram has been fully discussed together with the manner of operation as has likewise the manner of lubricating the ram to avoid friction and cutting of the barrel.

I have thus described specifically and in detail an apparatus embodying the features of my invention in the preferred form in order that the manner of constructing, operating and using the same and practicing and applying the invention may be fully understood, however, the construction of the apparatus and the arrangement of the same may be widely varied within the scope of the invention, the specific terms herein being used in a descriptive rather than in a limiting sense, and the scope of the invention being defined in the claims.

What I claim as new and desire to secure by Letters Patent is:

1. The combination in a portable power hammer having a ram, of means for communicating a reciprocating motion to the ram, of means for supporting the tool in the path of the ram, means for adjusting the position of said supporting means in the direction of the path of the ram to vary the character of the blow of the ram upon the tool, said adjusting means comprising a tubular member enclosing the lower portion of the barrel and carrying the said tool support, the barrel having an outwardly disposed flange at the bottom and the tubular member having helical slots and screws with slotted heads to receive said flange and adapted to slide in said helical slots and nuts having a threaded engagement with said screws and adapted to bear on the outside of said tubular member for holding the tool support in adjustive position.

2. The combination in a portable power hammer having a ram, of means for communicating a reciprocating motion to the ram, said means comprising a resiliently mounted plunger and a relief spring for checking the return stroke of the plunger, means for supporting the tool in the path of the ram, means for adjusting the position of said supporting means in the direction of the path of the ram to vary the character of the blow of the ram upon the tool, said adjustment comprising a helical interengaging means for moving the tool support in the direction of the path of the ram.

3. The combination in a portable power driven hammer having a rotating shaft, a ram mounted to reciprocate and means for driving the ram from said shaft, said means comprising a positively driven plunger, balanced springs on each side of the plunger communicating the motion to the ram, a relief spring to check the motion of the ram on the return or non working stroke only, relieving the balanced spring on the opposite side of the plunger and increasing the impact of the hammer upon the work.

4. The combination in a portable power hammer having a ram mounted to reciprocate, a rotating shaft, and means connecting the shaft to the ram to reciprocate the same, said means comprising a positively driven reciprocating plunger and balanced springs on each side of the plunger communicating the motion of the plunger in a modified form to the ram, the tension and relative values of the springs, and the speed of rotation being so proportioned as to give a cumulative effect of the spring tension on the momentum of the ram whereby the force of the blow is increased, and a relief spring to check the motion of the ram on the return or non working stroke only relieving the balanced spring on the opposite side of the plunger and further increasing the force of the blow.

5. The combination in a portable power hammer of a reciprocating ram, a rotating shaft and a plunger mounted to reciprocate, means for communicating the reciprocating motion to the ram, including a lever pivoted to swing on an arc in the general direction of the stroke, rotary means in the form of a crank engaging said lever at an intermediate point for actuating said lever, and a link pivoted at both ends and connecting the swinging end of the lever to said plunger, balanced springs on each side of the plunger supporting it on the ram and communicating the motion of the plunger in a modified form to the ram, and a relief spring for checking the upward motion of said plunger.

6. The combination in a portable power hammer of a reciprocating ram, a rotating shaft and a plunger mounted to reciprocate, means for communicating a reciprocating motion to the ram, including a lever pivoted to swing on an arc in the general direction of the stroke, rotary means in the form of a cam engaging said lever at an intermediate point for actuating said lever, and a link pivoted at both ends and connecting the swinging end of the lever to said plunger, balanced springs on each side of the plunger supporting it on the ram and communicating the motion of the plunger in a modified form to the ram, and a relief spring

for checking the upward motion of said plunger and projecting it downwardly.

7. The combination in a portable power hammer of a ram, positive means and a spring intervening between said positive means and said ram for communicating a reciprocating motion to the ram, a relief spring to check the motion of the ram on the non-working stroke relieving said intervening spring and increasing the impact of the hammer upon the work and means for supporting an anvil in the path of the ram, and means for adjusting the supporting means in the direction of the path of the ram to vary the length of the stroke of the ram and the character of the blow.

JAMES N. BAKER.