Feb. 3, 1942. G. D. BEHLEN 2,271,933

POWER HAMMER

Filed April 25, 1940 3 Sheets-Sheet 1

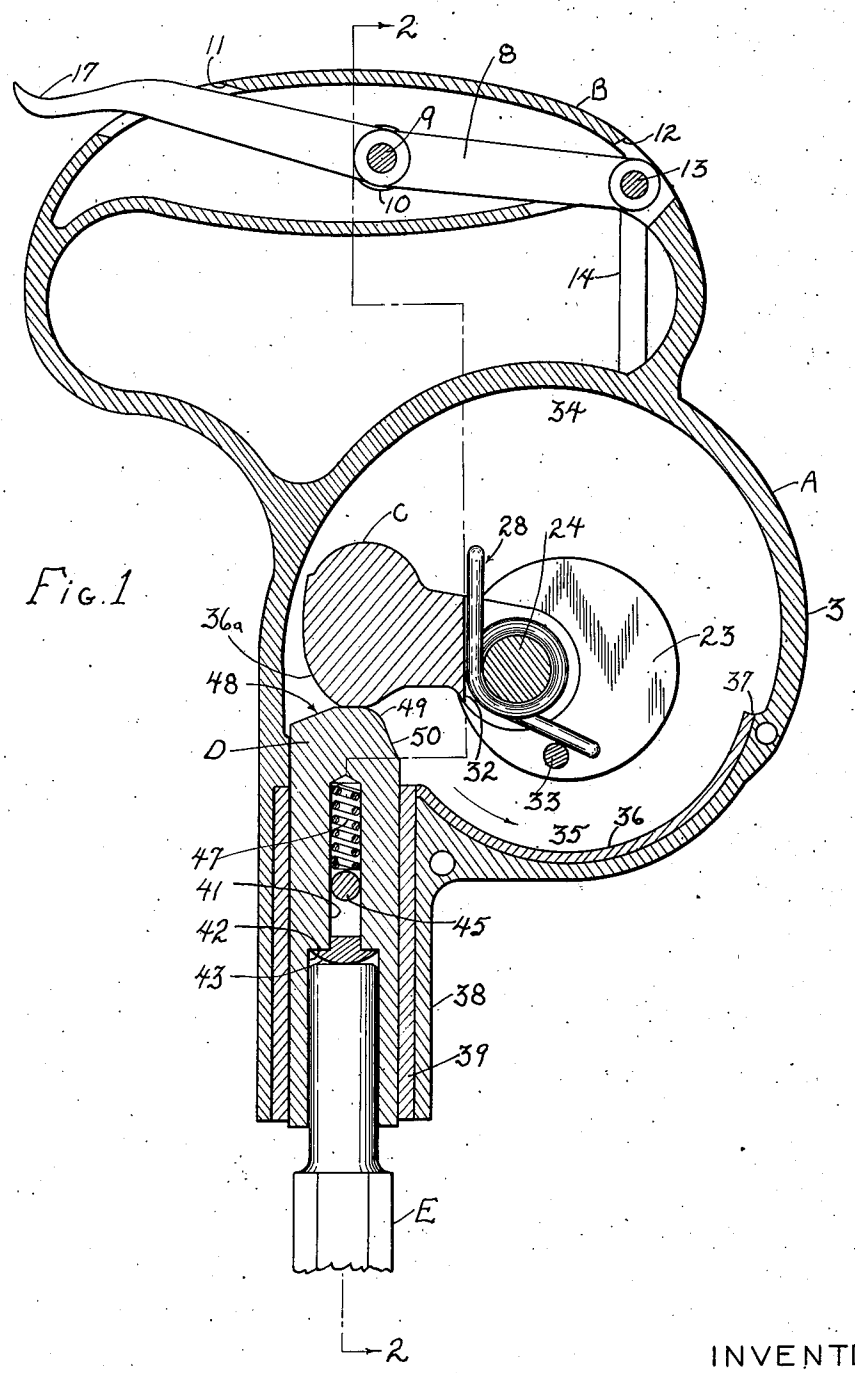


Fig. 1

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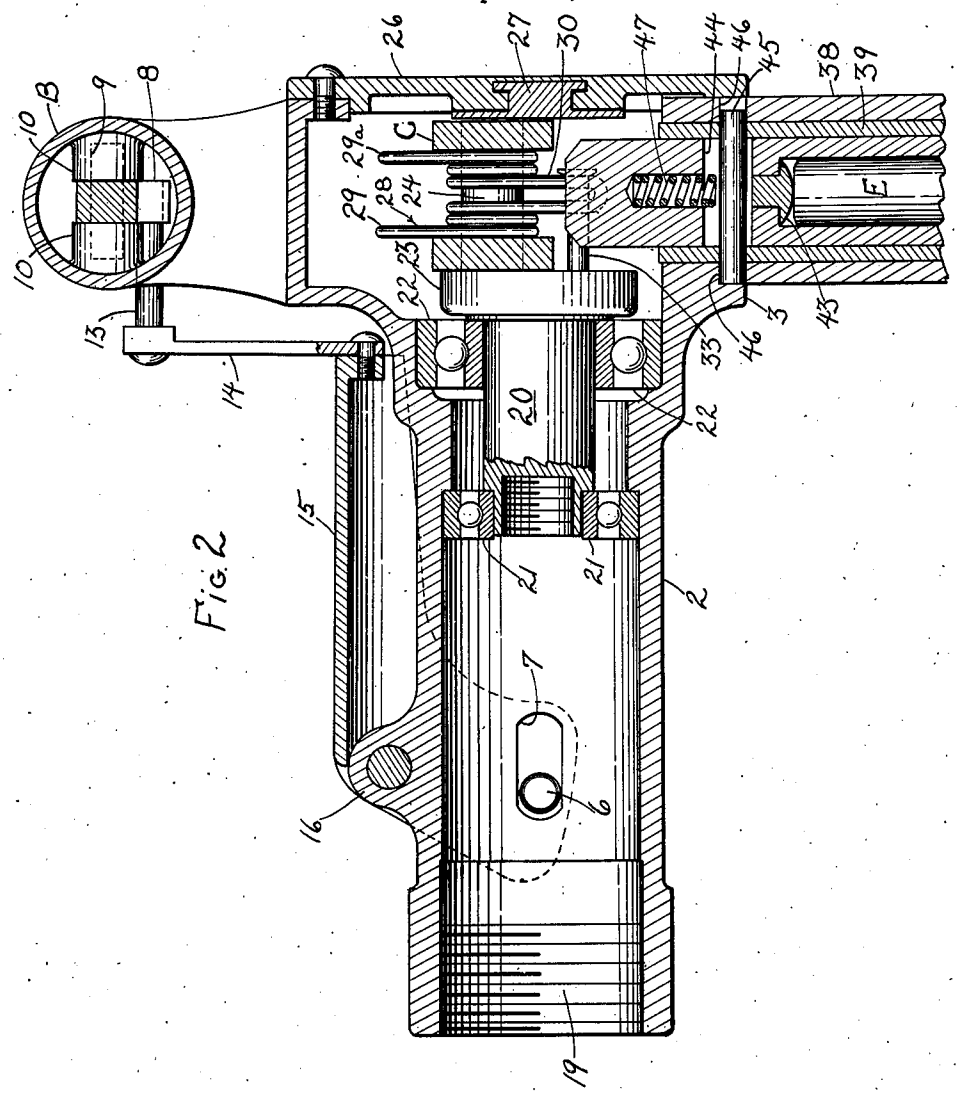


Fig. 2

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Fig. 3

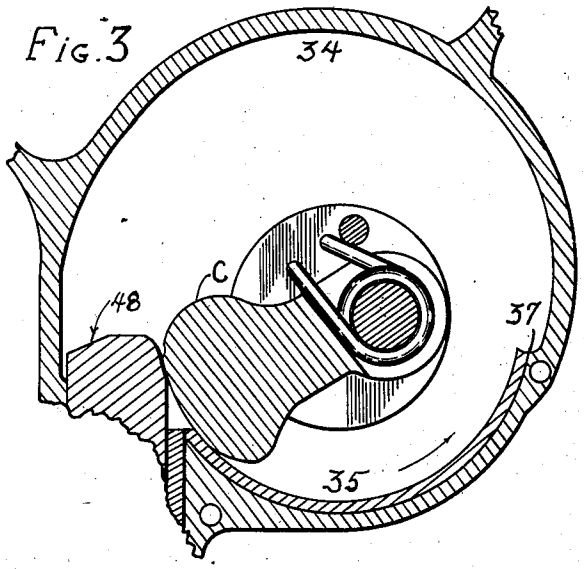
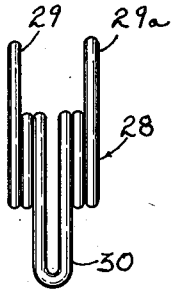


Fig. 6



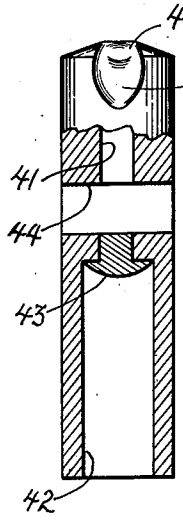
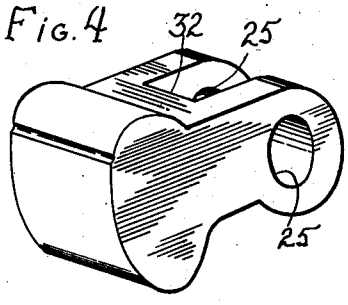


Fig. 5

Fig. 4



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UNITED STATES PATENT OFFICE

2,271,933

POWER HAMMER

George D. Behlen, Chicago, Ill.

Application April 25, 1940, Serial No. 331,609

6 Claims. (Cl. 125—33)

My invention relates to power driven hammers.

My invention has particular reference to the type of hammer which may be driven by either a flexible shaft or a rigid shaft. In the construction of a power driven hammer which may strike from 400 blows per minute up to 2,500, depending upon the size and capacity of the hammer, it is well known that each blow produces a corresponding reaction which must be controlled in order to prevent self-destruction of the hammer.

It has been known heretofore that the reaction from each striking blow of the hammer element may be dissipated back through the drive shaft, however, this is undesirable because of the deleterious effect upon the drive shaft and its associated parts. It has also been known to dissipate the reaction through the walls of the housing. This is also undesirable because of the deleterious effect upon the working parts of the tool and upon the operator.

The primary object of my invention is to control this reaction, not by dissipating it, but by utilizing it for energizing each successive blow of the hammer element. In this way I not only control the undesirable deleterious effect of the reaction, but, instead, I transform said reaction into useful working energy.

Another object of my invention is to increase the work output of each blow of the hammer element without increasing the work input. The important aspect of increasing the work output of the hammer without increasing the work input is emphasized by the commercial demand for a mechanical hammer which will compete with the well known pneumatic hammers.

A further object is to provide a cushioning means for the tool holder so as to reduce to a minimum the injurious consequences which result from operating the hammer without putting it to work.

A further object is to provide a convenient device for starting and stopping the hammer.

Another object is to provide a readily demountable housing cover which has a special bearing plate for preventing axial movement of the hammer element on its pivot.

Another object is to provide a special coil spring for energizing the working blow of the hammer element in which the tension exerted by the spring on the hammer element is equalized from end to end of the spring.

Another object is to control the releasing of the energy conserved by the coil spring so that the maximum benefit of said energy is imparted by the hammer element to the tool holder which receives the blow of the hammer element.

Other objects and advantages will be apparent upon reading the following description and upon examination of the drawings, in which:

Fig. 1 is a sectional view through one side of the hammer;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary sectional view similar to Fig. 1 but showing the hammer element in a different location within the housing;

Fig. 4 is a perspective of the hammer element alone;

Fig. 5 is a front view partly in section of the tool holder alone; and

Fig. 6 is a view of the spring alone.

In the preferred embodiment of my invention I have shown generally a housing A having a handle B formed integrally therewith, a hammer element C which revolves and strikes the tool holder D upon each revolution, and a tool E to which is transmitted each blow of the hammer element upon the tool holder.

The housing A is formed of an elongated portion 2 and a laterally extending portion 3 defining a chamber within which the hammer element C is adapted to rotate. A drive shaft, preferably flexible, (not shown) is adapted to be received in the elongated portion 2 of the housing. A suitable clutch (not shown) is also provided within the elongated portion of the housing in order that the operation of the hammer can be controlled from the handle B. The clutch is controlled by means of a pair of diametrically opposed studs 6 (only one of which is shown) which extend into the interior of the elongated portion 2 of the housing, through the elongated slots 7 in the housing wall. The studs are operatively connected to the clutch and movement of the studs in one direction along the elongated slots 7 causes engagement of the clutch and movement in the other direction causes disengagement.

The operation of the clutch is controlled by a manipulating lever 8 which is mounted within the hollow handle. The lever pivots about the pin 9 which extends transversely of the handle and is securely held in the bosses 10 which are formed integrally with the walls of the handle. Either end of the lever is free to move up and down within the cutaway portions 11 and 12 in the handle. Pivoted to one end of the lever 8 by means of pin 13 is a connecting rod 14 which

extends between the lever and the bracket 15. Bracket 15 is pivoted to a lug 16 which is formed integrally with the housing A. The studs 6 are secured to the bracket 15 and move therewith. The studs 6, as heretofore described, control the engagement and disengagement of the clutch. Thus when the operator presses down on the lip portion 17 of the lever 8 this causes the clutch to engage and starts the hammer to operate. A releasing of the downward pressure on the lip 17 causes the clutch to disengage and the hammer to stop operating. Thus it can be seen that the hammer can be operated from the handle of the tool, even though the source of power may be remote therefrom.

Referring to Fig. 2 a flexible shaft (not shown) may be received in the elongated portion 2 of the housing A and may be securely attached thereto in the threaded region 19. A stub shaft 20 is operatively connected to the clutch and flexible shaft and is driven by said flexible shaft. The stub shaft 20 is rotatably journaled in bearings 21 and 22 and is formed at one end with a head 23. Disposed eccentrically of the axis of said stub shaft and preferably formed integrally therewith is a pin 24 extending across the interior of the housing. One end of the hammer element C is bifurcated and each limb of the bifurcation has a cylindrical bore 25 therein which is axially aligned with the bore of the other limb. The bifurcated end of the hammer element C is adapted to slidably fit onto the eccentric pin 24 so as to be free to pivot about said pin. The free end of the pin 24 terminates in the plane defined by the exterior surface of the side wall of the hammer element which is adjacent the housing cover 26. The housing cover prevents the hammer element from sliding axially along the pin 24. The clearance between the side wall of the housing cover and the adjacent side wall of the hammer element is only sufficient to allow freedom of rotation of the hammer element. The housing cover has a special bronze insert 27 which is molded as part of the casting from which the housing cover 26 is formed. This insert serves as a bearing plate to limit axial movement of the hammer element. It can be seen that the hammer element and the spring 28 can be quickly replaced by removing the housing cover and sliding the hammer element off the pin 24.

The spring 28 is a special type of coil spring and is adapted to slidably fit onto the pin 24. The spring 28 is formed by coiling one end clockwise and the other end counter-clockwise as viewed in Fig. 6. By forming the spring in this manner each end of the spring has an outwardly extending stem 29 and 29a and midway between the ends of the spring is a U-shaped tongue 30 extending outwardly at a tangent to the coils of the spring. The stems 29 and 29a lie in a common plane and are also tangent to the spring coils the reason for which will presently appear.

The spring 28 is received in the recess defined by the bifurcated end of the hammer element and is journaled on the pin 24 as previously described. The stems 29 and 29a of the spring are adapted to abut against the shoulder 32 which forms the base of the bifurcated region of the hammer element. The U-shaped tongue portion of the spring is adapted to abut against a pin 33 which is preferably formed integrally with the stub shaft 20 and extends outwardly therefrom. The spring normally tends to urge the hammer element in blow striking direction. The tension exerted by the spring against the shoulder 32 of the hammer element is equalized throughout the spring from end to end thereof due to the aligned stems 29 and 29a at each end of the spring exerting an equal amount of pressure against the shoulder. This equalization of spring tension is conducive to smoother operation of the tool.

Referring to Figs. 1 and 3 the laterally extending portion 3 of the housing A defines a chamber within which the hammer element is adapted to rotate. This chamber consists of a region 34 having a radial dimension which is greater than the radial dimension of the remaining region 35 of the chamber. In the region 35 a bronze bearing plate 36 is fixedly mounted to the inner wall of the housing. At the point where the reduced region 35 meets the enlarged region 34 a step-off 37 is formed. When, upon rotation, the hammer element is passing through the region 35 of the chamber, it engages the bronze bearing plate 36 and when it passes through the enlarged region 34, it clears the wall of the housing. The exterior surface of the blow-striking end of the hammer element is rounded off at 36a to conform substantially to the arc defined by the inner surface of the bearing plate 36 so that the hammer element will ride smoothly against the bearing plate.

Formed integrally with the housing portion 2 and extending downwardly as a continuation thereof is a cylinder 38 having a sleeve 39 fixedly journaled therein. The sleeve 39 serves as a bearing for the tool holder D which is reciprocably mounted therein. The tool holder is provided with an axial bore 41 in its upper region which opens into a second and diametrically larger axial bore 42 which in turn opens into the lower end of the tool holder. The bore 42 is adapted to slidably receive the butt end of the tool or chisel E. A hardened tip 43 is pressed into the lower end of the bore 41 for transmitting the blow of the hammer element to the butt of the chisel E. The tool holder D is provided with a transverse slot 44 through which a pin 45 is journaled. The walls of the cylinder 38 are provided with diametrically opposed openings 46 through which the pin 45 is inserted. The pin 45 remains in a fixed position when inserted into the openings 46 and its function is to limit the reciprocative movement of the tool holder D and also to prevent the tool holder from falling out of the cylinder 38. Journaled in the bore 41 is a compression spring 47 which contacts with the pin 45 and normally urges the tool holder upwardly toward the hammer element. The function of the spring is to provide a cushioning means for the tool holder whenever the hammer is operated without the chisel E being applied to the work. It can be seen that when the chisel is being pressed against the work, there is a constant upward pressure on the tool holder which returns the tool holder into operative position for each succeeding blow of the hammer element. However, when the chisel is not being applied to the work and if there were no spring 47, then there would be nothing to urge the tool holder upwardly into position for succeeding blows of the hammer element and consequently the tendency would be for the hammer element to drive the tool-holder out of the housing.

At the upper end of the tool holder there is a head portion 48 adapted to receive the blow of the hammer element. The head portion 48 has a slide-way which comprises in its upper region a convex surface 49 and in its lower region a con-

cave surface **50**. The concave region **50** defines an arc which corresponds with the arc defined by the bearing plate **36**. Thus it can be seen that after the hammer element strikes a blow it readily slides over the surfaces **49** and **50** without any undue loss of momentum. The slide-way is also conducive of smoother operation of the tool.

In order to avoid unnecessary vibration due to the eccentricity of the hammer element relative to the axis of the drive shaft I may provide additional weight for the head **23** diametrically opposite the pin **24** so as to counterbalance the eccentric mass.

Operation

The hammer is operated by first pressing downwardly on the lip **17** of lever **8** which establishes a driving connection between the power source and the hammer element. The hammer element is thus caused to rotate in a counter-clockwise direction as indicated in Figs. 1 and 3. Immediately after the hammer element has struck the head of the tool holder it rebounds backwardly in a clockwise direction about its pivot, (pin **24**). It can be seen that by mounting the hammer element so that it is freely pivotal relative to the drive shaft, the reaction upon the drive shaft is negligible. During the backward anti-clockwise movement of the hammer element the spring **28** is caused to coil as shown in Fig. 3. Each additional unit of distance that the hammer element moves in rebound direction increases the opposing tension of the spring until the resistance of the spring equals the force of rebound movement, then rebound movement ceases. It is apparent that the energy which is present in the rebound movement of the hammer element is absorbed by the spring **28** which conserves this energy for future use. The energy is not wasted or dissipated through extraneous channels.

At the moment when the rebound movement of the hammer element reaches its limit, the continued rotation of the drive shaft has caused the eccentric pin **24** to assume the approximate position shown in Fig. 3. Consequently the position of the head of the hammer element relative to the head of the tool holder remains substantially unchanged during the period of rebound movement and upon the continued rotation of the drive shaft the head of the hammer element slides into contact with the bearing plate **36** without any undue jar to the housing wall. This desired condition of operation depends upon regulation of the size, capacity and resiliency of the spring **28**.

During the period of rotation when the hammer element is riding along the bearing plate **36**, the spring **28** retains its conserved energy. When the head of the hammer element reaches the step-off **37** this conserved energy is released, thereby increasing the blow-striking energy of the hammer element.

In addition to this increased working energy supplied by the spring **28** there is a still further source of increased working energy imparted to the hammer element. During the period of rotation in which the hammer element is passing the bearing plate **36**, the head of the hammer element is caused to lag behind its normal position, which is the position determined by drawing a radial line through the axes of the eccentric pin **24** and the drive shaft **20**. When the head of the hammer element reaches the step-off **37**, centrifugal force tends to cause the head of the hammer element to catch up to its normal position, thereby increasing the momentum of the hammer element, said increased momenum being utilized as increased blow-striking energy.

The step-off **37** is so located within the housing that this additional blow-striking energy, imparted to the hammer element by both the spring **28** and by the "catching up" of the hammer element, reaches its peak at the moment the head of the hammer element engages the tool holder. Thus it can be seen that I have provided a hammer which produces a powerful blow in proportion to its size, weight and motive power.

Having thus described my invention what I claim is:

1. A percussive device comprising a housing, a drive shaft associated therewith, a hammer element adapted to be rotated by said drive shaft, a tool holder slidably mounted for limited reciprocal movement relative to the housing and extending into the interior thereof for receiving the blows of the hammer element, and cushioning means within the tool holder for absorbing the blows of the hammer element upon the tool holder when the percussive device is being operated without being put to work, said cushioning means comprising a spring mounted in a bore within the tool holder.

2. A percussive device comprising a housing, a drive shaft associated therewith, a hammer element adapted to be rotated by said drive shaft, a tool holder slidably mounted for limited reciprocal movement relative to the housing and extending into the interior for receiving the blows of the hammer element, said tool holder having a transverse slot, a pin journaled through the slot for allowing the limited reciprocal movement of the tool holder, and cushioning means located within the tool holder for absorbing the blows of the hammer element upon the tool holder when the percussive device is being operated without being put to work, said cushioning means comprising a spring mounted in a bore within the tool holder.

3. A percussive device comprising a housing, a drive shaft associated therewith, a hammer element adapted to be rotated by said drive shaft, a tool holder slidably mounted for limited reciprocal movement relative to the housing and extending into the interior thereof for receiving the blows of the hammer element, said tool holder having a transverse slot, a pin journaled through the slot for allowing the limited reciprocal movement of the tool holder, and a spring journaled in a bore within the tool holder and adapted to abut against the pin, whereby the movement of the tool holder away from the housing is resiliently opposed by the spring.

4. A percussive tool comprising a housing, an anvil, a rotatable hammer element carrier, means for rotating said carrier, a pivot member extending from the carrier and located eccentrically of the axis of said carrier, said hammer element mounted for free swinging movement on the pivot member, a stop member extending outwardly from the carrier, a spring associated with the carrier and with the hammer element, whereby movement of the hammer element about the pivot member in rebound direction is resiliently resisted by the spring, said spring having a connection with the stop member and also the hammer element, said stop member being located relative to the pivot member, so as to permit the hammer element to move in rebound direction

throughout an arc of more than 120°, measured from the position of the hammer element the moment it strikes the anvil, means within the housing to cause the hammer element to lag behind its normal position, and other means for releasing the hammer element so as to allow said element to catch up to its normal position, thereby increasing the force of the blow of the hammer element on the anvil.

5. A percussive tool comprising a housing, an anvil, a rotatable hammer element carrier, means for rotating said carrier, a pivot member extending from the carrier and located eccentrically of the axis of said carrier, said hammer element mounted for free swinging movement on the pivot member, a spring associated with the carrier and with the hammer element whereby movement of the hammer element about the pivot member in rebound direction is resiliently resisted by the spring, means within the housing to cause the hammer element to lag behind its normal position, said means also serving to energize and to store blow-striking energy in the spring, and other means for releasing the hammer element so as to allow said hammer element to catch up to its normal position, said last means also serving to release the energy stored in the spring.

6. A percussive tool comprising a housing, an anvil, a rotatable hammer element carrier, means for rotating said carrier, a pivot member extending from the carrier and located eccentrically of the axis of said carrier, said hammer element mounted for free swinging movement on the pivot member, a spring having connection with the carrier and with the hammer element whereby movement of the hammer element in rebound direction is resiliently resisted by the spring, a cam track within the housing located in the path of rotation of the hammer element whereby said element is caused to lag behind its normal position and whereby the spring is energized, said energization being maintained throughout the extent of the cam track, the lagging condition of the hammer element and the energy stored in the spring being released when the hammer element reaches the end of the cam track, whereby maximum blow-striking force is imparted to the hammer element the moment it strikes the anvil.

GEORGE D. BEHLEN.