Dec. 22, 1931. S. BERMAN 1,837,197

ELECTROMAGNETIC HAMMER

Filed Nov. 14, 1930

Fig. 1

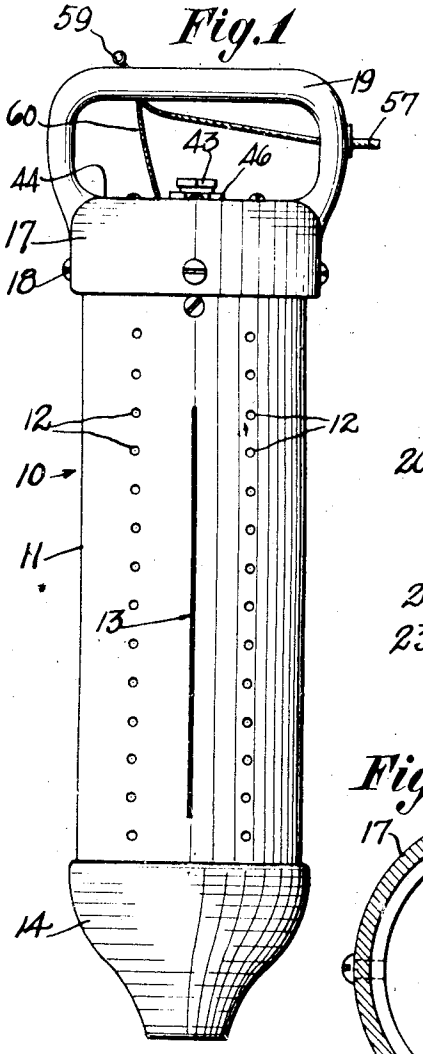


Fig. 5

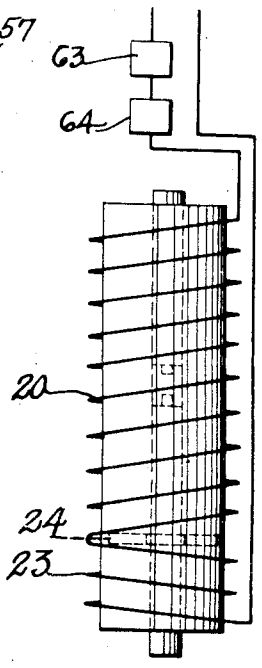


Fig. 2

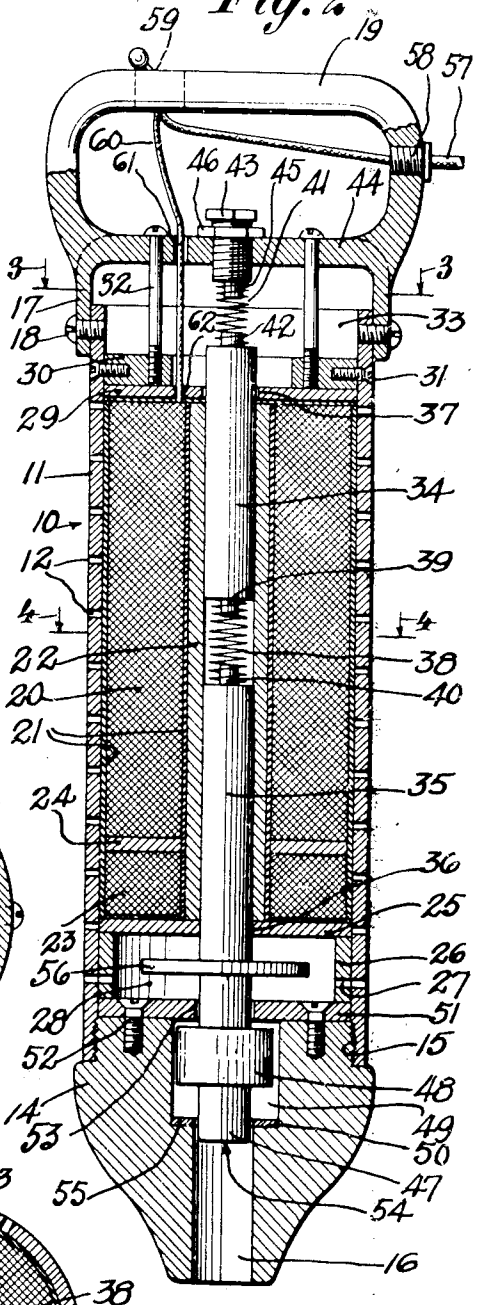


Fig. 3

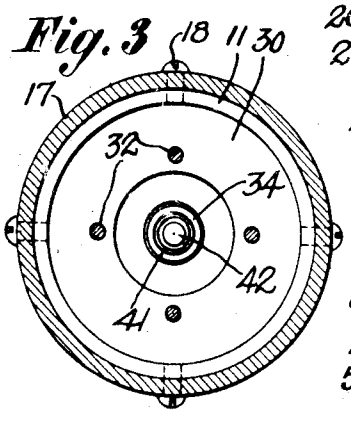


Fig. 6

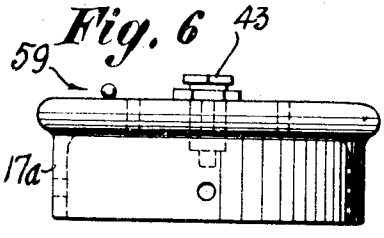


Fig. 4

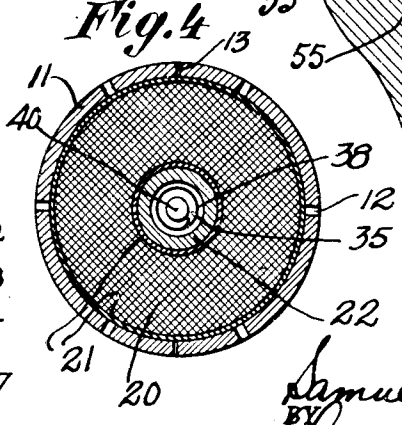
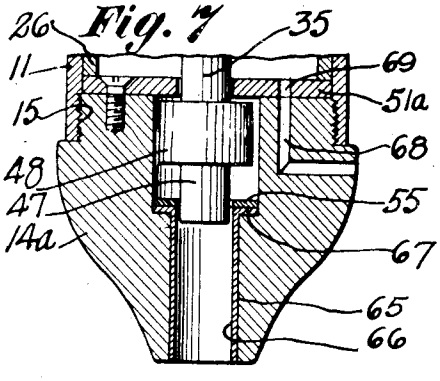


Fig. 7



INVENTOR
Samuel Berman
BY
Mick Shumacher
ATTORNEY

Patented Dec. 22, 1931

1,837,197

UNITED STATES PATENT OFFICE

SAMUEL BERMAN, OF BAYONNE, NEW JERSEY

ELECTROMAGNETIC HAMMER

Application filed November 14, 1930. Serial No. 495,578.

This invention relates to electric hammers, and has particular reference to devices of this character which are operated by electromagnets.

One object of the invention is to provide a device of the character described having an electromagnet, a plunger, relatively stationary means to cause a back kick of the plunger, and resilient means coacting in an improved manner to cause a resilient actuation of a tool simultaneously with the back kick.

Another object of the invention is the provision of an electric hammer having a plurality of movable parts coacting with an electromagnet and with resilient means opposing the former, whereby a re-enforcing interaction is caused between the movable parts to cause a reliable operation of a tool and yet in a resilient manner so that the principle may be used in hammers constructed not only for heavy work but also for fine and delicate work. More particularly, it is an object of this invention to provide an electromagnetic hammer in which a back or retraction coil is eliminated, and in which the use of springs for compression during the power stroke and subsequent retraction of the tool actuators is avoided because of the resulting loss of impact power.

Another object of the invention is to construct an electric hammer having a plurality of plungers co-operating with a solenoid and co-ordinated with each other for a strong actuation of a tool, by utilization of the maximum magnetic force of the solenoid, and with one of the plungers acting to re-enforce the other plunger during the power stroke.

Another object of the invention is to furnish an electric hammer having a main power coil and a demagnetizing coil in improved relation therewith and the casing parts of the electric hammer.

Another object of the invention is to provide an electromagnetic tool operating means and an improved casing which is slotted for reducing magnetic interference.

Another object of the invention is the provision of an electromagnetic reciprocating tool actuating means, and improved air cooling means therefor.

A further object of the invention is to produce an improved device of the type mentioned having relatively few and simple parts, and which is inexpensive to manufacture, assemble, or to take apart for inspection and repair, which can be made up in a wide range of sizes, and is convenient, rugged, and reliable and efficient in use.

Other objects of the invention and advantages thereof will become apparent as the specification proceeds.

With the aforesaid objects in view, the invention consists in the novel combinations and arrangements of parts hereinafter described in their preferred embodiments, pointed out in the subjoined claims, and illustrated on the annexed drawings, wherein like parts are designated by the same reference characters throughout the several views.

In the drawings:

Figure 1 is a view in side elevation of an electric hammer embodying the invention.

Fig. 2 is an enlarged vertical sectional view thereof.

Figs. 3 and 4 are transverse sectional views taken on lines 3—3 and 4—4 respectively of Fig. 2.

Fig. 5 is a schematic view showing the circuit.

Fig. 6 is a view in side elevation of a modified form of a top casing cap for very small sizes of the hammer.

Fig. 7 is a fragmentary sectional view showing a modification of the nozzle means for the hammer.

The advantages of the invention as here outlined are best realized when all of its features and instrumentalities are combined in one and the same structure, but, useful devices may be produced embodying less than the whole.

It will be obvious to those skilled in the art to which this invention appertains, that the same may be incorporated in several different constructions. The accompanying drawings, therefore, are submitted merely as showing the preferred exemplification of the invention.

Referring in detail to the drawings, 10 denotes the device embodying the invention.

The same may include any suitable casing 11, which can be made of any desired size, shape, or material, such as iron or aluminum, and may be cylindrical as shown. This casing may have a plurality of air openings 12, if required, the same being distributed as may be necessary. Also formed in the casing is a slot 13 which extends in a proper direction along the casing wall, or longitudinally as shown, in order to lie transversely to the turns of the electromagnetic coil as hereinafter described.

At the lower end of the casing 11 is a closure means which may be in the nature of a tool receiving nozzle 14. The same may be detachably connected to the casing in alinement therewith by any desired means such as screws or other locking elements, or the thread 15. Formed centrally in the nozzle 14 is an opening 16 of suitable size or shape for receiving the shanks or other parts of tools such as chisels, drills and the like.

At the upper end of the cylinder is a closure means such as a cap 17 which may be engaged with the cylinder in the same manner as the nozzle 14 or by means such as the screws 18. Extending upward on said cap is an integral handle whereby the tool may be readily manipulated.

Positioned in the casing 11 is a suitable power means which may derive its energy from any suitable source in any feasible form according to the particular features of the invention that may be employed. Preferably an electromagnetic means is utilized, and the same may assume various shapes and constructions consistent with a simple arrangement and high efficiency in performance. Thus I use a solenoid 20, which is of sufficient size for the work to be done and according to the voltage of the source of current. This solenoid is suitably insulated, for example, with asbestos 21 which protects against heat generated by the plungers as hereinafter described. Extending centrally through the solenoid is a guide element, such as a tube 22 which may consist of a non magnetic material such as brass.

At one end of the solenoid or main coil 20, is a secondary or demagnetizing coil 23. The latter is preferably disposed adjacent to that end of the casing which is near the nozzle head 14. The demagnetizing coil may be in series with the solenoid but reversely wound with respect thereto as shown in Fig. 5. Separating the demagnetizing coil from the solenoid may be a ring plate 24 of suitable insulating character, and the asbestos insulation 21 may also protect the demagnetizing coil. The guide tube 22 may extend continuously through the center of the demagnetizing coil up to an end retaining plate 25. The latter may be held in position by a spacer ring 26 which may abut the nozzle head 14. Said spacer ring may have holes 27 registering with holes 12 in the casing 11 to admit air to the chamber 28 formed by the spacer ring.

At the upper end of the solenoid may be a second retaining plate 29, held in position by means such as a ring 30. The latter may be secured to the casing 11 by headless or countersunk screws 31. Screws 32 may extend through the closure cap 17 into engagement with the ring 30 for re-enforcing connection. It is seen that by this arrangement a second chamber 33 is provided in the upper end of the casing 11.

Positioned in the guide tube 22 are plunger means including one or more plungers 34, 35. These plungers may extend beyond the ends of the solenoid through openings 36, 37 in the plates 25 and 29 respectively. While the portions of the plungers which lie within the solenoid may be of substantially equal size or length, it will be understood that these proportions may be varied according to the impulses to be imparted to the different plungers by the solenoid, and within the principles of operation hereinafter described. By providing a space between the plungers at approximately the longitudinal center of the solenoid, the magnetic forces acting therebetween are at a maximum.

Coacting with the plunger means or one of them is a resilient means, which may include springs that may operate with or in opposition to the solenoid according to the arrangement of parts within the principles of the invention. Thus a main compression spring 38 may be provided acting between the plungers 34, 35. This spring 38 may be in the form of a coil spring alined with the plungers and the ends of the spring taking around projections 39, 40 on the inner ends of the plungers 34, 35 respectively. By this arrangement, and as hereinafter set forth, plunger 34 constitutes the power plunger, while plunger 35 is the actuator or follower plunger.

Coacting with the plunger 34 may be a second resilient means such as a compression spring 41 which may be coiled to take tightly around a projection 42 on the outer end of the said plunger, the other end of the spring bearing against any relatively stationary member. The spring 41 may serve in the nature of a back kick and constitute a source of return or retraction energy for the plunger 34.

If adjustability in the resilient means is desired, for instance, to control the travel of the power plunger 34, this may be conveniently provided in connection with the spring 41, for instance, by a set screw 43 that is threaded through an opening in the wall 44 of the closure cap 17. This set screw, which is in alinement with the plungers, may have a projection 45 for holding the spring 41. To

lock the set screw in adjusted position, a lock nut 46 may be provided on the set screw.

The plunger 35 may actuate any suitable tool, directly or indirectly, that may be set into the nozzle head opening 16. Preferably, the end 47 of the plunger extends slightly into said opening 16. In order to limit the inward as well as the outward movement of plunger 35, where that may be necessary, the plunger may have a head or flange portion 48 received in a space or chamber 49 of the nozzle head and forming a stop shoulder 50. An opposite stop member 51 may be provided in the form of a plate secured to the nozzle head by screws 52, and having a central opening 53 for the passage of the plunger 35. The end face 54 of the plunger abuts the end of the tool shank and strikes the same. The impact with the nozzle head at shoulder 50 may be somewhat cushioned by a washer 55 of fiber or other suitable material seated on said shoulder. In this manner, should a tool be withdrawn while the machine is in operation, the plunger 35 will be prevented from flying out.

Normally, in the operation of the device, the stop member affords a back kick, and limits the retraction travel of the plunger 35. As a result, projection of the plunger 35 begins while the plunger 34 is still being retracted along its relatively longer path of travel, as hereinafter more particularly described.

To create a degree of ventilation in the casing 11, a vane or plate 56 may be secured to the plunger 35 in any suitable manner to reciprocate with the plunger. This vane 56 causes a circulation of air through the tube 22 backward to dissipate the heat generated by the plungers in the tube, and the tube has a clearance with the plunger for this purpose, which clearance being comparatively small, has not been shown.

For supplying current to the electromagnet, any feasible connections may be made. Thus a lead 57 may extend through a bushing 58 to a conventional switch 59 conveniently located on the handle 19. Thence a lead 60 may run through holes 61, 62 to the electromagnet to supply current to the solenoid 20 and the demagnetizing coil 23.

If the line current be D. C., a conventional vibrator or make and break device may be used which operates at a desired speed. If the current be A. C., then a half wave rectifier 63 and a choke coil 64 of any standard design may be placed in the line circuit at any suitable point.

The operation of the device will now be briefly described. Assuming that A. C. current is used, a current represented by only half a wave and, therefore of constant direction, enters the electromagnet. This current is suitably controlled to cause the electromagnet to be intermittently energized and de-energized. While any desired control means may be used, it will be noted that during a positive wave of current, the electromagnet may be energized, while when a negative or opposite wave occurs and is cut out by the rectifier, the electromagnet is de-energized. This will obviously cause an intermittent operation. The demagnetizing coil may be about one-fifth the size of the solenoid and demagnetizes the front or lower end of the plunger 35 to prevent magnetic leakage through the same and the nozzle head, but concentrates the magnetism in the plunger 35. Moreover, sticking of the parts due to magnetism, as, for instance, between the tool and the plunger 35 is prevented. The coil 23 acts particularly when the solenoid 20 is de-energized, as during a wave which is cut out by the rectifier; it helps demagnetize the plunger and the entire machine, and prevents losses by hysteresis and temperature rises as a result thereof. The same result is aided by the slot 13 which extends along the casing transversely to the direction of the turns of the electromagnet and hence cuts off magnetic interference and flow except in the general longitudinal direction, and prevents the casing from acting as a secondary with the power coil as a primary avoiding generation of heat.

In operation, the plunger 34 has a relatively large travel, while the plunger 35 has a comparatively small travel. When the electromagnet is energized, the power plunger 34 moves inward to compress the spring 38 against the actuating plunger 35 which is only slightly retracted. When the electromagnet is de-energized, the power spring 38 acts upon the plunger 35 to impart a sharp quick impulse thereto, while the plunger 34 moves rearward against the spring 41 which cushions the rebound and saves the energy of the power plunger by returning the same to the electromagnet. Upon the return stroke during the next cycle, the plunger 35 experiences a back kick at the stop 51, cutting short its retraction and serving to project the plunger 35. During this time, the plunger 34 is still being retracted, so that it continues its movement in the same direction and re-enforces the projection of the plunger 35. Moreover, the gap between the plungers is substantially at the longitudinal center of the solenoid, where the available power of the solenoid is at a maximum. I have found that in actual test this arrangement increases the power of the machine by about twenty per cent, and makes it possible to manufacture very small electric hammers for efficient operation.

It will be understood that the power of the plunger 34 may be sufficient to compress the spring 38 to the degree where the projections 39, 40 abut each other. When the plungers are released to travel under the power of the spring 38, the latter functions in the

superior manner described to yield substantially all its energy to the plunger 35 which has the short travel and abuts the tool.

By adjusting the set screw 43, the length of the stroke of the power plunger 34 may to some degree be regulated, and the number of vibrations of this plunger may within a narrow range be adjusted. Thus if the set screw is moved outward the number of vibrations may be diminished (some of them being skipped), while when the set screw is moved inward the number of vibrations are increased and may correctly correspond with the number of times that the electromagnet is energized. Ordinarily the set screw is given only one initial adjustment, as in the factory, and need not later be adjusted. This machine may produce 3600 vibrations or blows per minute.

The electromagnet is preferably made of enamel wire, each layer being coated with orange shellac. When heat is applied thereto, the layers unite into a single mass which is heat proof to a high degree. The asbestos layers 21 moreover protect the coils against any heat that may be frictionally generated by the plungers, and such heat is ordinarily dissipated by air forced through the tube 22 by the vane 56.

By reason of its construction, the machine may be quickly assembled and disassembled. The latter is important for inspection and repair, and may be effected by detaching the nozzle head. Thereupon the plungers and the springs come out easily.

In Fig. 6 is shown a modified closure cap 17*a* for the casing 11, in which the handle 19 is eliminated. This cap is used on very small hammers, the cap being held in the palm of the hand. The hammer may thus be conveniently manipulated for engraving and like operations. In all other respects, this device is similar to the foregoing and includes the set screw 43 and switch 59.

In Fig. 7 is shown a modification particularly of the nozzle head 14*a*, where the same may be made of aluminum. In that case the opening 65 may have a steel liner 66, flanged at 67, and the fiber washer 55 resting on the flange. Air openings to the chamber 28 may be formed at 68, 69 through the nozzle head and the stop plate 51*a* respectively. In all other respects this device is similar to the main or preferred form of the invention, and it will be appreciated that a large part of the device may be constructed of aluminum for lightness.

It will be appreciated that various changes and modifications may be made in the device as shown in the drawings, and that the same is submitted in an illustrative and not in a limiting sense, the scope of the invention being defined in the following claims.

I claim:

1. A hammer including a solenoid, a power plunger therein having a tool actuating head spaced from the solenoid, a follower plunger in the solenoid alined with the power plunger and adapted for substantial retraction by the solenoid, said plungers being spaced from each other to afford an air gap intermediate of the ends of the solenoid, a resilient means between the ends of the plungers, a second resilient means acting on the opposite end of the follower plunger in opposition to the first resilient means, a stop on the power plunger, and a relatively stationary abutment back of the stop and in relatively close proximity thereto to limit the retraction thereof, whereby when the solenoid is energized the plungers are retracted compressing the first resilient means and affording a back kick to the power plunger so that the same is projected while retraction of the follower plunger continues in coaction with both resilient means.

2. A hammer including a solenoid, a power plunger therein having a tool actuating portion, a follower plunger in the solenoid alined with the power plunger and adapted for substantial retraction by the solenoid, said plungers being spaced from each other, a resilient means intermediate the inner ends of said plungers, said resilient means being compressed by the plunger upon energization of the solenoid and serving to move the plungers apart upon release thereof, back kick means for the follower plunger to return the same in retraction, stop means for the power plunger to limit the retraction thereof under actuation of the solenoid and to afford a back kick therefor in the normal operation of the hammer so that the power plunger has a substantially shorter path of travel than the follower plunger, whereby the power plunger is projected during retraction of the follower plunger.

3. A hammer including a solenoid, a power plunger therein having a tool actuating portion, a follower plunger in the solenoid alined with the power plunger, means tending to move the follower plunger outward of the solenoid, abutment means for limiting the retraction of the power plunger under actuation of the solenoid so that the power plunger has a substantially shorter path of travel than the follower plunger, said plungers being spaced for a substantial retraction of the follower plunger upon energization of the solenoid, and the follower plunger exerting during such retraction a force on the power plunger for projection thereof after back kicking of the latter against the abutment means.

4. A hammer including a solenoid, a power plunger therein having a tool actuating portion, a follower plunger in the solenoid alined with the power plunger, means tending to move the follower plunger outward of the solenoid, abutment means for limiting the re-

traction of the power plunger under actuation of the solenoid so that the power plunger has a substantially shorter path of travel than the follower plunger, said plungers being spaced for a substantial retraction of the follower plunger upon energization of the solenoid, and the follower plunger exerting during such retraction a force on the power plunger for projection thereof after back kicking of the latter against the abutment means, the point of spacing between the plungers being intermediate the ends of the solenoid, and a demagnetizing coil at an end of the solenoid adjacent to the power plunger.

In testimony whereof I affix my signature.

SAMUEL BERMAN.