

W. LEWIS.
POWER-HAMMER.
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Fig. 2.

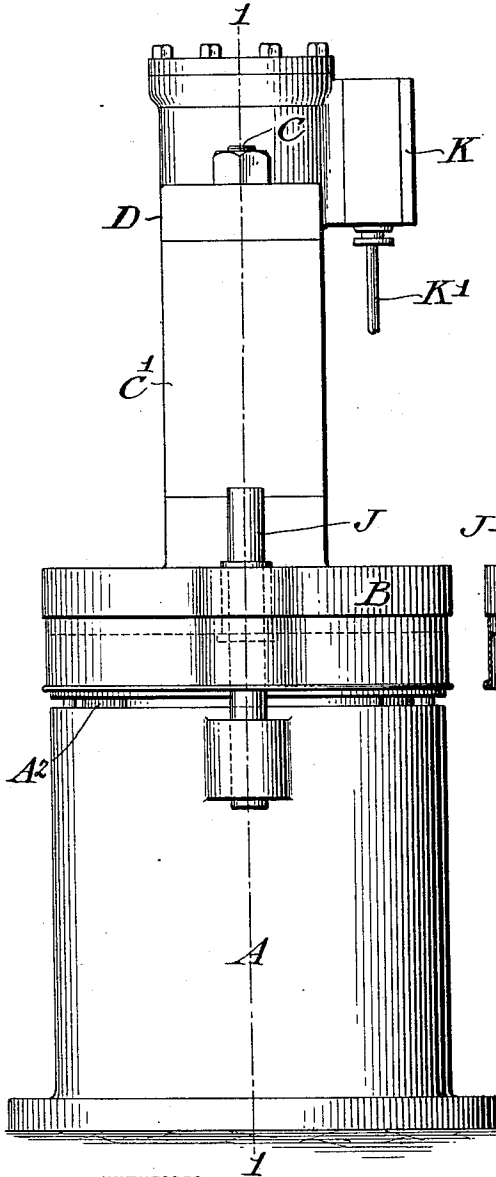
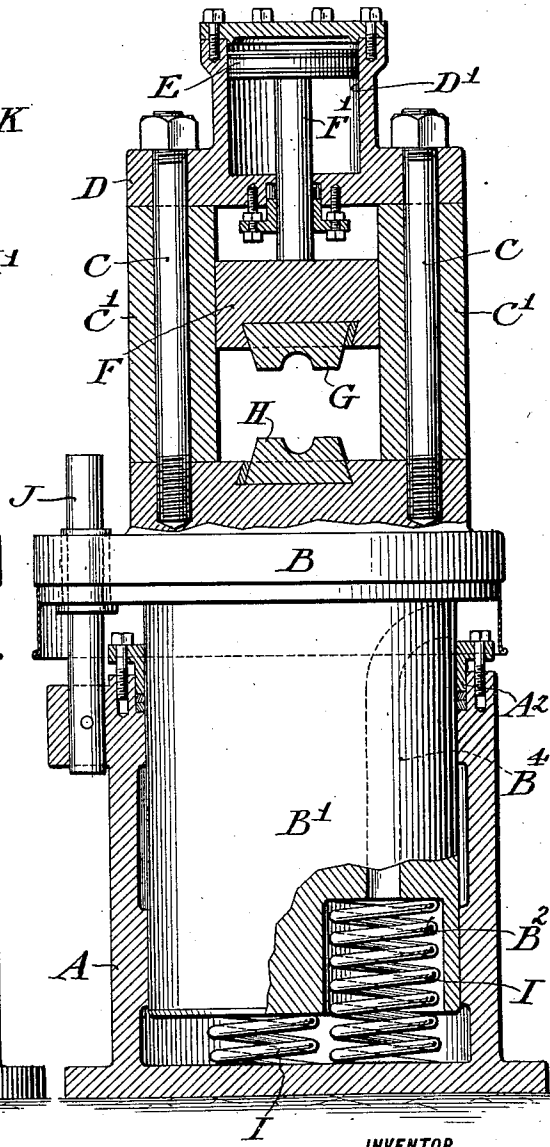


Fig. 1.



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POWER-HAMMER.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WILFRED LEWIS, a citizen of the United States of America, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented a certain new and useful Improvement in Power-Hammers, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

The present invention relates to power hammers, such as are used in forging metal, and has for its object to provide a novel construction whereby the hammers may be operated without the transmission of injurious shock to the foundations upon which the hammers rest and the practical efficiency of the hammers is increased. I accomplish this by making the anvil, as well as the tup or upper die, or work striking part, and attached parts, movable relative to a stationary support, and by making provisions for giving the anvil a movement of approach toward the tup as the latter moves toward the anvil in striking a blow such that at impact the momentum of the anvil is substantially equal or at least is comparable in amount, though opposite in direction, to the momentum of the tup. With a hammer constructed and operating in this manner there is no shock produced at each blow of the hammer to be transmitted to the foundation or support, since the momentum of the tup is neutralized in whole or in large part by the momentum of the anvil, each serving to arrest the velocity of the other when the blow is struck. Moreover, this arrangement increases the practical efficiency of the hammer since none of the energy of the striking part is employed in moving the anvil after the blow is struck, as is ordinarily the case with power hammers as practically used. Theoretically, the maximum efficiency in the operation of a power hammer is obtained with an anvil of infinitely great weight. This, of course, is never possible of attainment in practice, though under favorable circumstances occasionally met with it is possible to approximate it by mounting the anvil on bed rock. Usually, however, the foundation for the anvil is more or less yielding, and in order to prevent objectionable tremors or vibrations in the foundation

or foundation support it is common practice to mount the anvil on a cushion such as is formed by a wooden crib.

Where the anvil is mounted on a yielding support such as is formed by a wooden crib, and the weight of the tup is equal to the weight of the anvil, the striking part, or tup, will lose half of its velocity at impact and the anvil will acquire the velocity lost by the tup or hammer and both will move together at one-half the striking velocity of the hammer. The energy discharged upon the wooden crib is therefore that due to double the weight of the hammer at one-half its striking velocity or one-half the energy in the hammer. Therefore one-half is discharged upon the forging and one-half upon the wooden crib, assuming, of course, the resistance of the wooden crib is less than that of the forging, as is usually the case. Increasing the weight of the anvil in this case increases the efficiency which may be expected as the ratio of the weight of the anvil to the sum of the weights of the anvil and tup. In practice the anvil has usually been made about nine times as heavy as the tup, and the efficiency has therefore been about ninety per cent.

Where, in accordance with the present invention, the momentum of the anvil is equal or approximately so, but opposite in direction, to the momentum of the tup, the total energy of the tup and anvil is imparted to the forging at impact, regardless of the relative weights of the tup and anvil and the efficiency of the hammer is the same as if the floating anvil has been replaced by a stationary anvil of infinite weight.

In practice I prefer to give the anvil its momentum by mounting it on a resilient cushion formed by air or like expansible fluid under pressure, or preferably by steel springs, or by steel springs in conjunction with expansible fluid under pressure, but the resilient cushion which I employ differs from the cushions formed by wooden cribs and the like heretofore used in that it has a very much greater amplitude of motion. The cushion which I employ is of such a character that it tends to hold the anvil when subjected only to the force exerted against it by the anvil while the tup is falling, up to a level substantially above that

at which impact occurs. Theoretically, the tension of the cushion which I employ should be maintained constant, as the anvil rises and falls, but in practice I have found
 5 that it is sufficient to employ long helical steel springs, as the change in the tension of the springs occurring during the range of movement of the anvil is not sufficient to produce any substantial preponderance in
 10 the momentum of the tup at impact.

Where the wooden crib support is used, the amplitude of motion of the cushion formed by the crib is small, and while of course the anvil does rise and fall in the
 15 operation of the hammer, the anvil is stationary and has no momentum at the instants at which impact occurs, so that the resilient cushion formed by wooden cribbing or the like yielding foundations heretofore employed do not correspond in any
 20 way, either in function or results produced, to the resilient cushion which I employ.

The various features of novelty which characterize my invention are pointed out
 25 with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it, reference may be had to the accompanying
 30 drawings and descriptive matter in which I have illustrated and described one of the many forms in which the invention may be embodied.

Of the drawings: Figure 1 is a sectional elevation of a steam hammer for die forging, constructed in accordance with my invention, the section being taken on the line
 35 1—1 of Fig. 2, and Fig. 2 is an elevation taken at right angles to Fig. 1.

In the drawings A represents the base of the machine, which is in the form of an up-
 40 standing cylinder, open at its upper end.

B represents the anvil of the hammer, provided with a piston extension B' at its
 45 lower end, which works in the cylinder chamber in the base A.

J represents a guide pin employed to prevent the anvil from rotating relative to the base. At the top the anvil B has secured
 50 to it in the usual manner the lower die member H.

The tup, comprising the heavy cross head F, the upper die G carried by it, the piston stem F', and the piston E, is supported
 55 above the anvil by means of a cross head D. The latter is secured to the anvil by bolts C, and is spaced away from the anvil by the heavy distance pieces C'. The cross head D has formed in it a cylinder chamber D'
 60 in which the piston E works.

K represents the valve casing, and K' the operating stem of the valve (not shown) working in the casing K, and by means of which pressure fluid may be admitted to
 65 and exhausted from either end of the cylin-

der chamber D' to cause the piston E and its attached parts to be raised and lowered relative to the anvil proper.

The anvil is supported upon a group of helical steel springs I, which rest upon the
 70 bottom of the cylinder chamber in the base member A, and have their upper ends received in pockets B², formed in the lower end of the piston extension B' of the anvil. To damp out secondary oscillations of the
 75 anvil a stuffing box A² may be provided at the upper end of the base A, through which the piston extension B' works.

B⁴ represents a passage through which air may pass into and out of the chamber A' or through which pressure fluid may be ad-
 80 mitted and exhausted if desired.

In the operation of the particular embodiment of the invention disclosed, a pressure fluid, as steam, is first admitted to the lower
 85 end of the chamber D' to raise the tup relative to the anvil, and the lower end of the chamber D' is then connected to exhaust, and permit the tup to fall, the work being inserted between the dies H and G while
 90 the tup is up. The falling movement of the tup may or may not be accelerated as conditions make desirable, by the action of the pressure fluid alternately admitted to and
 95 exhausted from the upper end of the chamber D'. In the initial condition of the apparatus the anvil and tup carried by it are held at the level at which the weight of the anvil and tup is balanced by the springs I.

As the pressure fluid is admitted to the lower end of the chamber D' and the tup is being raised, practically no change in the position of the anvil is produced, for the weight of the tup is still being borne by the
 100 anvil, and through it by the springs I. When the lower end of the chamber D' is connected to exhaust and the tup begins to fall, the weight of the tup is taken off the anvil, which immediately moves upward under the action of the springs I, to meet the
 105 tup. If pressure fluid is admitted to the upper end of the cylinder chamber A' to accelerate the falling movement of the tup, the rising movement of the anvil is correspondingly accelerated by the re-action of the fluid pressure against the upper end of the cylinder D', employed to increase the velocity of the tup. Regardless of whether or not fluid pressure is admitted to the upper end of the cylinder D' to accelerate the
 110 movement of the tup, the springs I will impart an upward velocity to the anvil while the tup is falling, such that when the work held in the die H is struck by the die G the momentum of the anvil will be substantially equal, though opposite in direction to the momentum of the tup. The retardation of the movement of the parts and the decrease in the tension of the springs I, occurring as the anvil is arrested, tend to
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prevent the anvil from acquiring a momentum fully equal to that of the tup. With a suitably designed machine, however, the difference in the momentums of the tup and anvil is comparatively small, and from a practical standpoint may be disregarded, so far as the efficiency of the machine and the transmission of shock to the foundation is concerned. Since the momentum of the anvil, as I have pointed out, is substantially equal to the momentum of the tup, the anvil and tup each substantially destroy the velocity of the other and the energy of each is delivered to the engaged dies G and H. The slight preponderance of momentum of the tup acquired in practice with the particular embodiment of the invention disclosed, from the level at which it is engaged by the anvil, is without practical significance.

The rising and falling movements of the anvil may be disadvantageous when a number of blows are to be struck on very large and unwieldy objects, but the rising and falling movement of the anvil is not objectionable in many cases and for many different classes of work, and in particular is a negligible factor in die forging. I may remark here that the invention is particularly useful in die forging because of the great desirability of employing die forging hammers in places such as upper floors of buildings and the like, where hammers constructed in accordance with the present invention may be used, and it is out of the question to use a forging hammer as heretofore constructed.

While the tension of the springs I, vary as the anvil rises and falls and the static floor load varies accordingly, this variation is only equal to a fraction of the total weight of the hammer and is in no way comparable to the shock transmitted to the support for a hammer with a non-floating anvil.

While, in accordance with the provisions of the statute, I have herein described and illustrated the best form of my invention now known to me it will be apparent to those skilled in the art that many changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a power hammer the combination with the vertically movable tup and the anvil of substantially greater mass than the tup located below the latter and a support on which the anvil is mounted and with respect to which it is vertically movable, of means for causing the tup and anvil to move vertically toward each other and relative to the support to deliver a hammer blow and with such velocities that the momentum of each tends to destroy the momentum of the other to a substantial extent when the blow is struck.

2. In a power hammer the combination with the anvil of a support in which the anvil is mounted for vertical movement, a tup mounted on the anvil for vertical movement, means for alternately exerting a thrust between the anvil and tup to separate them preparatory to striking a blow and for thereafter permitting the tup to fall toward the anvil, and a resilient cushion between the anvil and support tending to lift the anvil and adapted to give the anvil an upward velocity while the tup is falling such that when the blow is struck the momentum of the tup is substantially neutralized by that of the anvil.

3. In a power hammer for die forging, the combination with a support formed with an upstanding cylinder and an anvil having a piston portion movable therein in said cylinder, a die carried by the anvil, a cylinder fixed to the anvil above said die, a tup having a piston working in the last mentioned cylinder and a die cooperating with the anvil-carried die, means for alternately admitting a pressure fluid to and exhausting it from the two ends of said last mentioned cylinder, and a spring support acting between said anvil and support tending to lift the anvil and adapted to give it an upward velocity while the tup is moving toward it such that when the blow is struck the momentum of the tup is to a large extent neutralized by the momentum of the anvil.

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Witnesses:

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D. STEWART.