Feb. 19, 1924. 1,484,490

R. GOLDSCHMIDT

MECHANICAL HAMMER

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Fig. 1

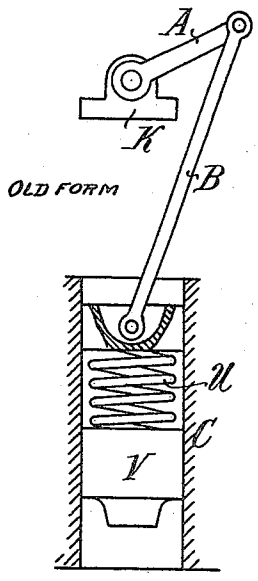


Fig. 2

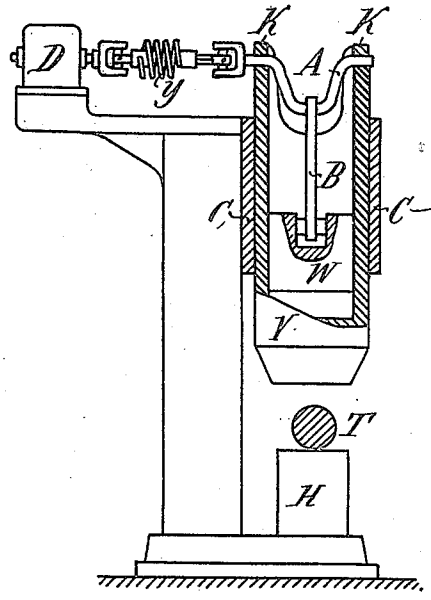


Fig. 3

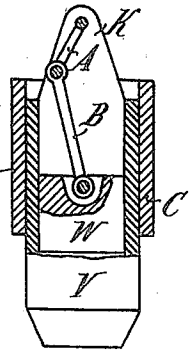


Fig. 4 Fig. 5 Fig. 6

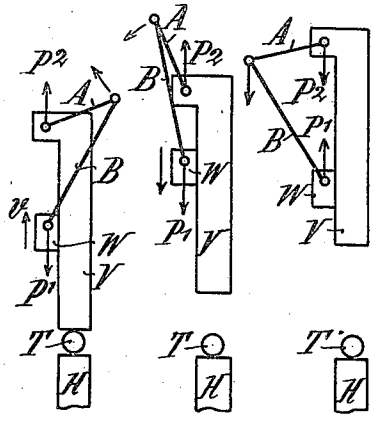
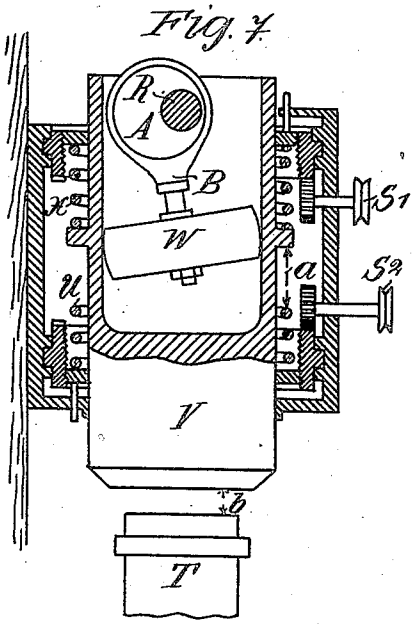


Fig. 7



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MECHANICAL HAMMER

Filed April 14, 1921 4 Sheets-Sheet 2

Fig. 8.

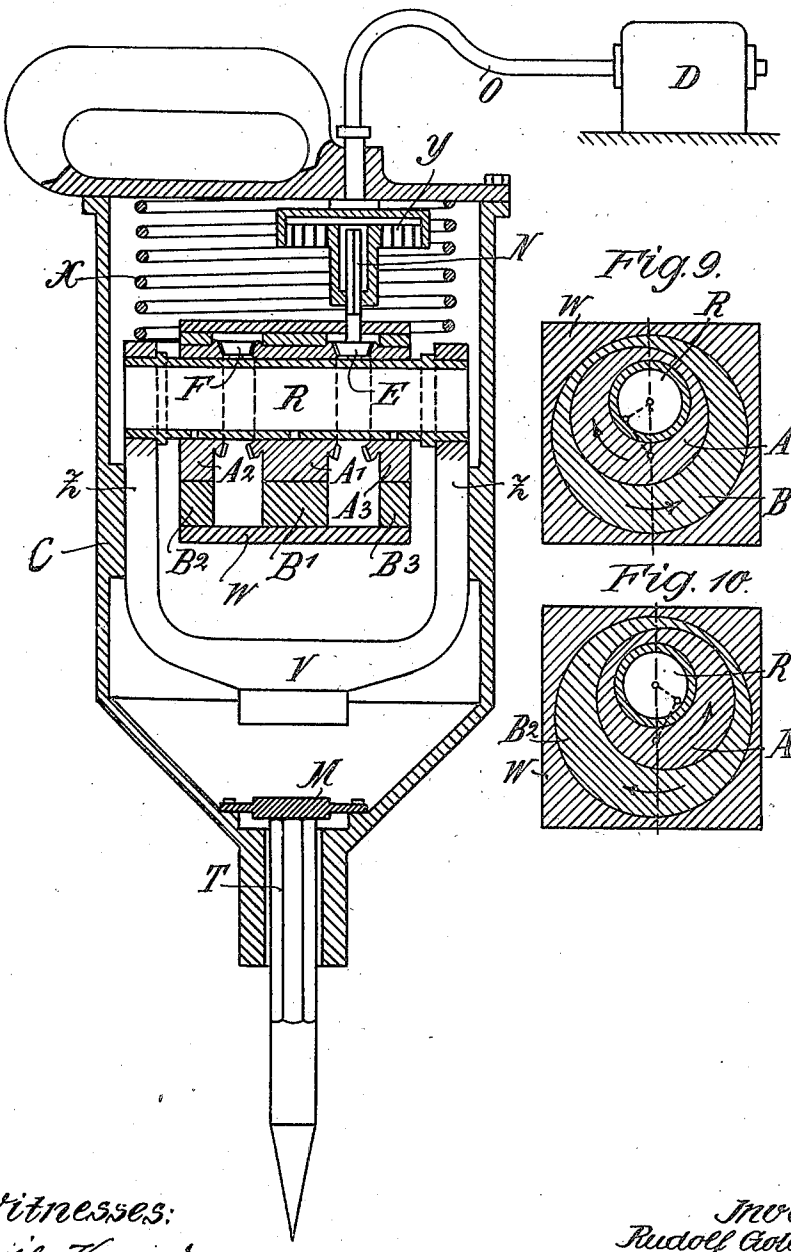


Fig. 9.

Fig. 10.

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MECHANICAL HAMMER

Filed April 14, 1921 4 Sheets-Sheet 3

Fig. 11.

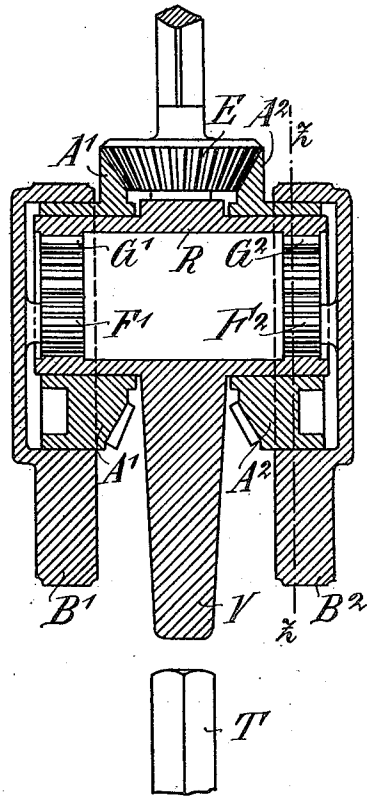
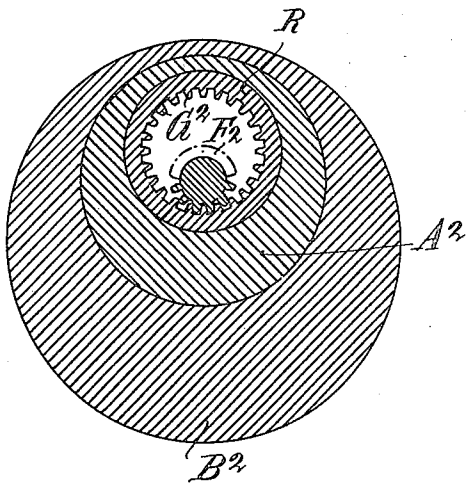


Fig. 12.



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MECHANICAL HAMMER

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Fig. 13.

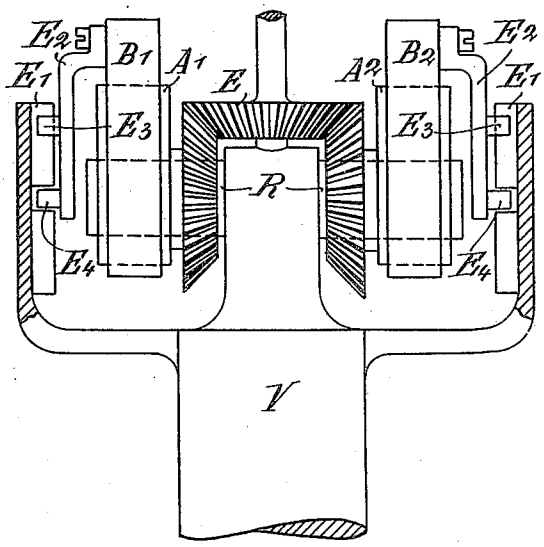


Fig. 14

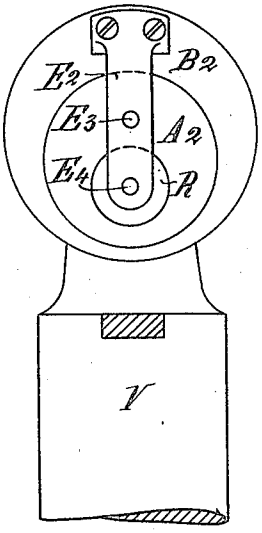


Fig. 15.

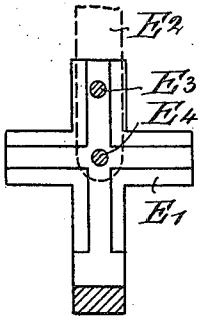
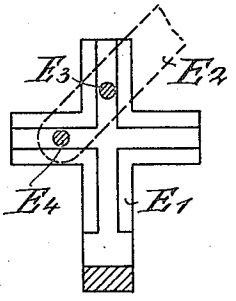


Fig. 16



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Patented Feb. 19, 1924. 1,484,490

UNITED STATES PATENT OFFICE.

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MECHANICAL HAMMER.

Application filed April 14, 1921. Serial No. 461,446.

To all whom it may concern:

Be it known that I, RUDOLF GOLDSCHMIDT, a German citizen, residing at 45 Linden Allee, West End, Berlin, Germany, have invented new and useful Improvements in Mechanical Hammers, of which the following is a specification.

This invention relates to mechanical hammers and consists essentially in effecting the storage of energy in the tup by the reaction of the bearings of an element or elements movable relatively to the tup.

In order that the invention may be more clearly understood reference will hereinafter be made to the accompanying drawings whereon:

Fig. 1—old form—is a diagrammatic view of a known type of mechanical hammer.

Fig. 2 is a side view partly in section showing one form of the present invention.

Fig. 3 is a side view partly in section taken at right angles to Fig. 2.

Figs. 4, 5 and 6 are diagrammatic illustrations of the hammer shown in Fig. 2 in three different positions.

Fig. 7 is a sectional view of a modified form of mechanical hammer or pile driver.

Fig. 8 illustrates a further modified construction of the present invention applied to a hand hammer or percussive hand tool.

Figs. 9 and 10 are detail sectional views of the mechanism shown in Fig. 8.

Figure 11 is a sectional view showing a further modified construction of the improved mechanism, and Figure 12 is a sectional view on the line Z—Z of Figure 11.

Fig. 13 is a fragmentary view of the improved mechanism applied to a reciprocatory tup of a hammer and Fig. 14 is an end view of the mechanism shown in Fig. 13.

Figs. 15 and 16 are detail views of the pin-and-slot mechanism employed in the mechanism shown in Figs. 13 and 14.

Referring to Fig. 1 which illustrates a common form of actuating mechanism for the tup V of a hammer, driven by means of a crank A and connecting rod B, it is usual to interpose a spring U between the crosshead of the connecting rod and the tup in order to give the latter slight freedom of movement relative to the positive movement of the crosshead. The provision of a spring however presents structural difficulties, as part of the power is absorbed by the spring instead of being imparted to the tup. The construction is therefore always comparatively large and heavy and subject to considerable vibrations.

The object of the present invention is to drive the tup of the hammer by simple mechanical means so that it shall have sufficient freedom of movement and to provide an arrangement in which the highest possible velocity shall be attained at the moment when the blow takes place.

In order to attain this object, the forces reacting on the crank bearing K (Fig. 1) are utilized to drive the hammer. According to the present invention and as shown in Fig. 2, the crank bearing K is mounted on the tup V which can reciprocate vertically between the guides C. At its upper end the tup V carries the crank A which is rotatable in the bearings K and driven by a spring Y. By means of a universal coupling and longitudinal flexible shaft, the driving mechanism does not impede the movement of the tup. The spring Y is wound up by the motor D. The function of the spring will be hereinafter more fully described.

By means of the connecting rod B, the crank is connected to a weight W which is freely movable vertically in a guide in the tup V. H represents an anvil on which a block T is to be forged. When the crank A is rotated, the weight W is reciprocated and reacts through the crank A upon the bearings K. As the bearings are movable with the tup V, the tup is thus set in reciprocatory motion. Within certain limits of speed the operation will be as follows; reference being made to Figs. 4, 5 and 6:—

Assuming the tup V to be in its lowermost position and resting upon the work T and assuming that the weight W has passed its point of maximum velocity v, as in Fig. 4, and that it is retarded by the force P_1, then a reaction P_2 will be produced in the crank bearing K, the reaction P_2 being equal to the force P_1. The reaction P_2 raises the tup and varies in magnitude, reaching its maximum when the weight W has reached its uppermost position and is again moving downwardly (Fig. 5). The force P_2 changes in direction when the weight W has passed its middle position (Fig. 6); thereafter

the force P_2 acts in conjunction with the force of gravity to accelerate the downward movement of the tup.

The force of the blow may be increased if the tup is loaded not only by the force of gravity but by other downwardly acting forces, such as a spring. In the case of hammers which are to operate horizontally or in a vertically upward direction, this spring serves not only to increase the force of the blow but also to absorb the recoil.

Fig. 7 illustrates a resilient or spring-controlled hammer or pile driver. The driving shaft R mounted in the tup V actuates the weight W by means of an eccentric A and rod B.

A spring X acts upon the tup V and is adjustable by means of a toothed wheel and gearing from an external pulley S_1. A lower spring U is provided for moderating and regulating the force of the blow. Normally this spring is disposed so low down that the distance *a* is greater than the distance *b*, so that the spring U is ineffective. If the height of the spring U is adjusted by rotation of the wheel S_2, part of the kinetic energy of the tup V will be taken up by the spring U and in the extreme position, the tup V will no longer strike the pile T.

The spring X should be so arranged that it acts on the tup with a practically constant force. This may be attained by imparting to the spring such an initial compression that its force is only slightly altered on further compression. If the stroke for example is ten centimetres, a spring would be selected compressed by say one metre in length before insertion in the casing. In the case of hand hammers a constant force is important as a spring of insufficient initial tension would lead to undesirable vibrations.

Cranks and connecting rods are not always the best means for actuating the weight W. In the first place, on account of the vibrations in the bearings set up by the blows of the tup of the hammer, the diameter of the shaft will generally require to be so great that the crank and connecting rod must be replaced by an eccentric. In such case in order to suppress vibrations at right angles to the direction of the blow, the weight W may be driven by means of two sets of eccentrics which rotate at the same angular velocity but in opposite directions.

Fig. 8 illustrates a hand hammer having the aforesaid modifications. The tup V is guided in a casing C. R is a cross pin fixed on the tup and on which the eccentrics A_2 and A_3 rotate in the same direction. The eccentric A_1 rotates thereon in the opposite direction. These eccentrics are driven through gearing E and F and a longitudinally movable square shaft N from a coil spring Y which in turn receives its power from the shaft O and motor D. The eccentrics A_1, A_2 and A_3 each rotate within an outer eccentric B_1, B_2 and B_3 respectively. The outer eccentrics B_1, B_2 and B_3 turn loosely in a heavy element W and, as the eccentric A_1 rotates in the opposite direction to the eccentrics A_2 and A_3, the eccentrics B_1, B_2 B_3 are compelled to turn (see Figs. 9 and 10) within the element W, the eccentric B_1 rotating in the opposite direction to the eccentrics A_1, B_2 and B_3. To equalize the forces acting on the element W, the eccentrics A_1 and B_1 are together equal in weight to the total mass of the eccentrics A_2, A_3, B_2 and B_3. The element W is thus reciprocated by the eccentrics and does not require any special guiding means, other than its support on the eccentrics B_1, B_2 and B_3. The operation will be more readily understood by reference to Figs. 9 and 10 which illustrate the position assumed when the eccentrics A_1 and A_2 have rotated through approximately 45 degrees from the vertical centre line. It will be seen that the eccentrics A_1 and A_2 each tend to turn within its surrounding eccentric but that, in doing so, they react upon each other through the cross-pin R, this reaction compelling the eccentrics B_1 and B_2 to turn in the opposite directions to A_1 and A_2 respectively. Since B_1 rotates in the opposite direction to B_2 and B_3, the element W is prevented from turning with any of the eccentrics B_1, B_2 or B_3. The eccentrics are so adjusted on the cross-pin R that the parts of greater radius are always in line on the vertical centre line of the cross-pin (see Fig. 8) and consequently the reactions on the element W reach their maximum when the eccentrics pass over their upper and lower dead centres. As the eccentrics reciprocate with the element W, they supplement the actual weight of the latter, which may thus be relatively negiligible. M is a membrane closure for the interior of the casing C and against which the tup V is adapted to strike.

Various other mechanical means may be adopted for obtaining the relative movement between the element W and tup V, such as planet gearing, links and the like. For supplying lubricant and in order to reduce weight the axle R is preferably constructed as a thin walled tube.

Figs. 13 to 16 illustrate a construction in which eccentrics A_1 A_2 B_1 and B_2 are employed without an element W. The eccentrics A_1 and A_2 are driven in opposite directions by gearing E interposed between the eccentrics. The eccentrics B_1 and B_2 are caused to rotate about the eccentrics A_1 and A_2 by means of the cross shaped slots E_1 in which guide blocks or rollers E_3 and E_4 are movable, the latter being fixed on arms E_2 carried by the eccentrics B_1 and B_2. In Fig. 16 the eccentric B is turned through 45°.

Instead of the pin-and-slot connection, the movement of the eccentrics B_1 and B_2 may be effected by planet gearing or like means.

The eccentrics in Fig. 13 rotate upon a unilaterally fixed axle or journal R thus avoiding the difficulty of forking the tup V as a supporting means.

The peripheries of the eccentrics B_1 and B_2 do not require to be circular. The necessary eccentricity of the centre of gravity of the masses however determines to some extent the shape of both eccentrics.

In the construction shown in Figs. 13 to 16, the eccentrics A_1 and B_1 are together equal in weight to the eccentrics A_2 and B_2 taken together. Since A_1 rotates in the opposite direction to A_2 and since B_1 and B_2 must turn about A_1 and A_2 respectively in opposite directions, and furthermore, by reason of the eccentrics being so adjusted that their greatest radii are in line vertically (as seen in Fig. 14), the eccentrics react on the cross-pin R and set the latter in vertical reciprocation.

Figs. 11 and 12 illustrate a construction having a hollow axle R upon which rotate eccentrics A_1 and A_2 having teeth engaging a driving pinion E. The eccentrics A_1 and A_2 are thus driven in opposite directions. Pinions F_1 and F_2 are carried internally by eccentrics B_1 and B_2, the pinions F_1 and F_2 engaging internal teeth G_1 and G_2 on the hollow axle R. In this case, also, the eccentrics B_1 and B_2 are rotatable on the eccentrics A_1 and A_2 respectively and are caused to rotate in opposite directions by the gearing F_1, G_1 and F_2, G_2 and, as the greatest radii of the eccentrics are in line vertically (as seen in Fig. 12) the reaction of the eccentrics on the axle R reciprocates the latter, which carries the tup V.

The driving mechanism preferably comprises a spring Y (Figs. 2 and 8) which is continuously or intermittently wound up by means of a motor or by hand. The torque on the crank A (Fig. 2) or shaft E (Fig. 8) varies according to the degree of acceleration of the mass W and also according to the amplitude of the stroke. Immediately after the blow, considerable power is required to lift the tup. Consequently in order to avoid strain on the prime mover or driving gear and shafts, the mechanism is driven by means of a spring such as a clock spring, which will vary in angular velocity to such an extent as to prevent shocks. Immediately after the blow, when the tup V comes to rest, the mechanism driven by the spring will rotate very slowly and gradually increase in angular velocity until the next blow takes place.

Claims.

1. A mechanical hammer comprising a reciprocatory tup, an element movable in relation thereto, and mechanism journaled on said tup for reciprocating said element and tup.

2. A mechanical hammer as specified in claim 1 provided with means for subjecting the tup to a unidirectional force.

3. A mechanical hammer as specified in claim 1 provided with a spring acting in a forward direction upon the tup.

4. A mehcanical hammer as specified in claim 1 provided with a spring initially under considerable stress and acting in a forward direction upon the tup.

5. A mechanical hammer as specified in claim 1 in which the mechanism comprises eccentric driving gear.

6. A mechanical hammer comprising a reciprocatory tup, an inner rotatably driven eccentric journaled on the tup and an outer eccentric mounted on the inner eccentric.

7. A mechanical hammer comprising a reciprocatory tup, a plurality of inner oppositely driven eccentrics journaled on the tup and a plurality of outer eccentrics mounted on said inner eccentrics.

8. A mechanical hammer as specified in claim 6 having a weighted element supported by the outer eccentric.

9. A mechanical hammer as specified in claim 1 in which the mechanism imparts a rotary path to the centre of gravity of the movable element.

10. A mechanical hammer comprising a reciprocatory tup, a plurality of elements movable in relation thereto and mechanism journaled in said tup for actuating said elements in opposite directions to each other.

11. A mechanical hammer as specified in claim 1 having a spring for resiliently driving said mehcanism.

12. A mechanical hammer as specified in claim 6 in which the inner eccentric is journaled on a cross pin fixed to the tup.

13. A mechanical hammer as specified in claim 6 in which the inner eccentric is journaled on a hollow cross pin fixed to the tup.

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