C. HUBER.

APPARATUS FOR WORKING METAL.

APPLICATION FILED NOV. 8, 1907.

926,985. **Patented July 6, 1909.**

Fig. 1.

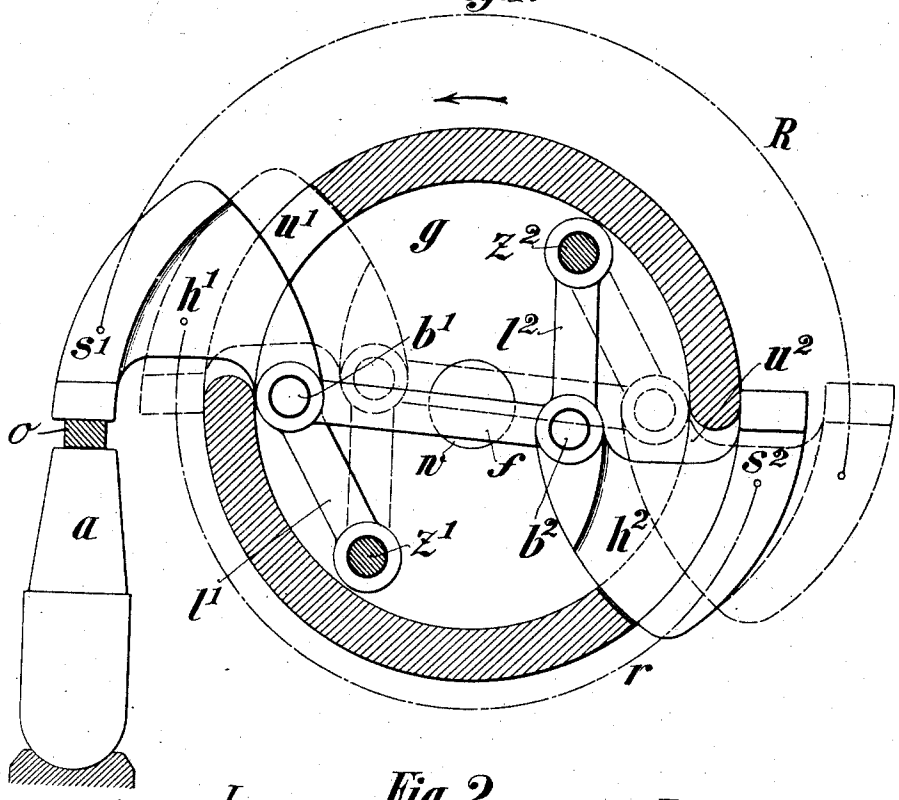
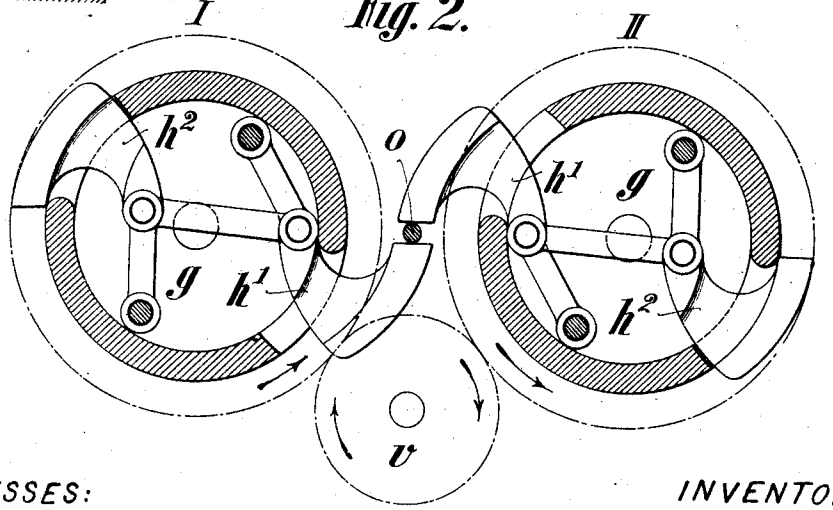


Fig. 2.



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APPARATUS FOR WORKING METAL.

No. 926,985. Specification of Letters Patent. Patented July 6, 1909.

Application filed November 8, 1907. Serial No. 401,251.

To all whom it may concern:

Be it known that I, CARL HUBER, engineer, a subject of the Grand Duke of Baden, residing at No. 16 Friedrichstrasse, in Berlin, in the Kingdom of Prussia, Germany, have invented certain new and useful Improvements Relating to Apparatus for Working Metal, of which the following is a full, clear, and exact description.

This invention relates to a new apparatus for working metal and refers more particularly to forging apparatus and the like, that is to say, those apparatus in which the shaping of the work is effected by impact action.

An especially effective form of the present invention consists of two adjacent rotating rapid hammer systems working together, so that without the use of an anvil, which, as known, absorbs power, the work is acted upon on both sides, whereby all expended energy is converted into forging work. The two rotating systems are preferably made to co-act, for instance, by being connected by toothed gear, in order that the blows should act on both sides of the work simultaneously, uniform forging being effected by this simultaneous working on both sides. The loss of power thus obviated, which otherwise occurs when using an anvil for forging by a considerable amount of the power of the blow being absorbed by the anvil, is of great importance, so that the above described apparatus is of the utmost importance from the point of view of the economical use of power.

In the accompanying drawing, which shows two arrangements of rotating hammer systems embodying the invention: Figure 1 is a simple hammer system with anvil, the rotating hammers only acting from one side on the work, while Fig. 2 shows two co-acting hammer systems for working metal in the manner hereinbefore described, whereby the work is acted upon from both sides by the hammers.

In the construction shown in Fig. 1, a is the anvil, h^1 and h^2, the two hammers of the system, s^1 and s^2, the centers of gravity of the hammer parts, g, the rotating hammer housing or hammer support, l^1 and l^2, the connecting rods, f, a fixed connecting rod or spring, z^1 and z^2, fixed bolts or spindles, b^1 and b^2, movable bolts or pins, u^1 and u^2, slotted apertures for the guidance of the hammers, w, the shaft, and o the work. As regards the mode of operation of this rotating hammer system with its two movable hammers in the housing, the whole system should be considered in action in the direction indicated by the arrow, while supposing, as shown in the drawing, the center of gravity s^1 of the hammer h^1 to have already traversed the upper half of its course on the outer large or active circle R, and the center of gravity s^2 of the hammer h^2 to have completed its course on the lower half but on the inner small or inactive circle r. The energy of the hammer element h^1, $\frac{m\,V^2}{2}$ on the circle R was greater during this course than that of the hammer h^2, as the speed V was greater in the proportion of the radii of the circles R and r respectively. It follows that the hammer h^1 had the greater power during the half revolution, and with its superior power compelled the hammer h^2 to impinge on the housing circumference and to keep to the smaller inactive radius with the lower speed v.

In the position of the hammers shown in the drawing, the operation changes. The anvil a with the object o to be forged thereon lies in the course of the large circle. As soon as said object is struck by the hammer h^1, the latter will have lost at one blow all the energy, $\frac{m\,V^2}{2}$, which it collected during its rotation, and will have exerted it on the work to be forged in the form of compression work. Hence the hammer h^1 has lost all its energy. At the same moment, however, the hammer h^2, having traversed the lower course on the small radius, has a store of energy, $\frac{m\,V^2}{2}$, whereas the hammer h^1, connected to it by the rod or spring f, has no more power. The consequence is that the hammer h^2, by means of its greater store of energy, holds back the dead hammer h^1 on the housing, away from the active course, and passes into the active course on the large active circle R by suddenly passing into the position shown by dotted lines, and pulls back the hammer h^1, which latter is now obliged to remain on the small circle r in exactly the same manner as the hammer h^2 was previously obliged to do. The hammer h^1 which, directly after having struck the work, is pulled back by the hammer h^2 until it is in contact with the cir-

cumference of the housing, is now able to pass the anvil without touching the same. In this manner the alternate operation of the hammers h^1 and h^2 is repeated.

It is obvious that in this construction at least two, four, or any equal number of hammers may be operative on the circumference of a housing; two hammers would, however, generally suffice. The hammer in this case strikes twice to every revolution and may be directly coupled to a belt, electromotor, steam turbine or the like.

Alterations may be made in the construction of the arrangement by substituting a tension spring or pressure spring for a rigid connecting rod. In this case the connecting rods l^1 and l^2 would require to be crank levers in order that the pressure spring could be put under tension. By using a spring two objects are attained. Firstly, it would be a connecting member between the two hammers in a similar manner to a rigid rod, so that the one hammer should influence the other. Secondly, when the machine is not working the spring would cause both of the hammer elements to impinge in the circumference of the housing and prevent them from hanging down. For starting the machine the anvil a may be pivoted to its seat so that it can be swung out of the course of the hammers during the first few revolutions. When the machine is started both hammer elements, by the increase of their speed, would be lifted off the housing by centrifugal force, in a similar manner to the balls of a governor. This equal outward swing of the hammers would, of course, not give the desired result. Therefore, as soon as the hammers have made a number of revolutions, the anvil would have to be put into position in order that the hammers could do their work. Hence as soon as one of the hammers loses its even small amount of energy at its first blow on the anvil, the other hammer takes up a position on the outer active course and compels the first to return to the inner inactive course. Thus the necessary impetus is given and an outer and inner course on the upper and lower side of the housing is formed in order to guide the active hammer, immediately after having expended its energy, out of the outer course into the inner inactive course, past the work or anvil, and to allow it to pass again into the outer course at the right moment. It is obvious that, in order to attain this purpose, the hammer elements must be diametrically opposite one another and be connected, and that there must be two for such a change in operation without having to resort to curved paths and other mechanism the use of which means the loss of the chief advantage, namely, that the whole self-acting change of operation should not begin too soon nor too late and should only take place when the active hammer has done its work. Other means, such as compressed air or the action of an electric solenoid and the like, may take the place of the spring.

As regards the arrangement shown in Fig. 2, which will be readily understood by referring to the already mentioned process, it should be briefly explained that the two hammer systems, I, II, are arranged opposite one another on either side of the work o, a mutual gearing v being provided in order to insure a uniform drive of the two systems. The construction of each system is here the same as that of the construction shown in Fig. 1; however, as already mentioned, and this is the great advantage, the anvil is absent, as during the simultaneous action on both sides of the work, that is to say, on the top and bottom of the same, the hammers themselves form the support for the work instead of the anvil, so that all power expended is utilized without any loss whatever for changing the shape of the work under treatment.

What I claim as my invention, and desire to secure by Letters Patent is:

1. An apparatus of the class described including in combination a plurality of hammers rotating about a common axis and each adapted to move either in an active path or in an inactive path, and means for holding one of said hammers in its inactive path when another is in its active path.

2. An apparatus of the class described including in combination a pair of hammers, a rotating support on opposite sides of the axis of which said hammers are mounted with freedom to move outward or inward, and connecting means between said hammers for causing one to move inward as the other moves outward.

3. An apparatus of the class described including in combination a pair of hammers h^1 h^2, a rotating support g therefor, rods l^1 l^2 pivoted at opposite sides of the axis of said support and pivotally connected to said hammers respectively, and a connecting rod f between the ends of said rods l^1 and l^2 for causing one of said hammers to move inward as the other moves outward.

4. An apparatus of the class described including in combination a pair of mechanisms each including a rotating hammer adapted to be retracted toward its center of rotation when it strikes the work, said hammers being arranged to strike the work simultaneously at opposite sides so as to be retracted and pass each other.

5. An apparatus of the class described including in combination two mechanisms each comprising a plurality of hammers rotating about a common axis and adapted to move either in an active path or in an inactive path, and means for holding one of said hammers in its inactive path when another

is in its active path, said two mechanisms being arranged to engage and strike opposite sides of the work simultaneously with the hammers from the two mechanisms respectively, and means for rotating said two mechanisms synchronously.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

CARL HUBER.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.