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METHOD OF FORGING

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Fig. 1.

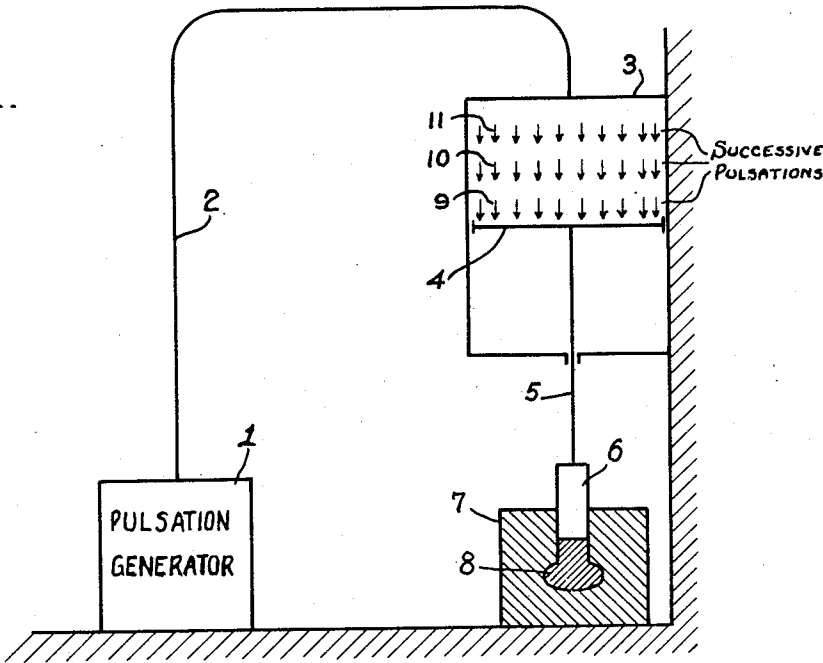
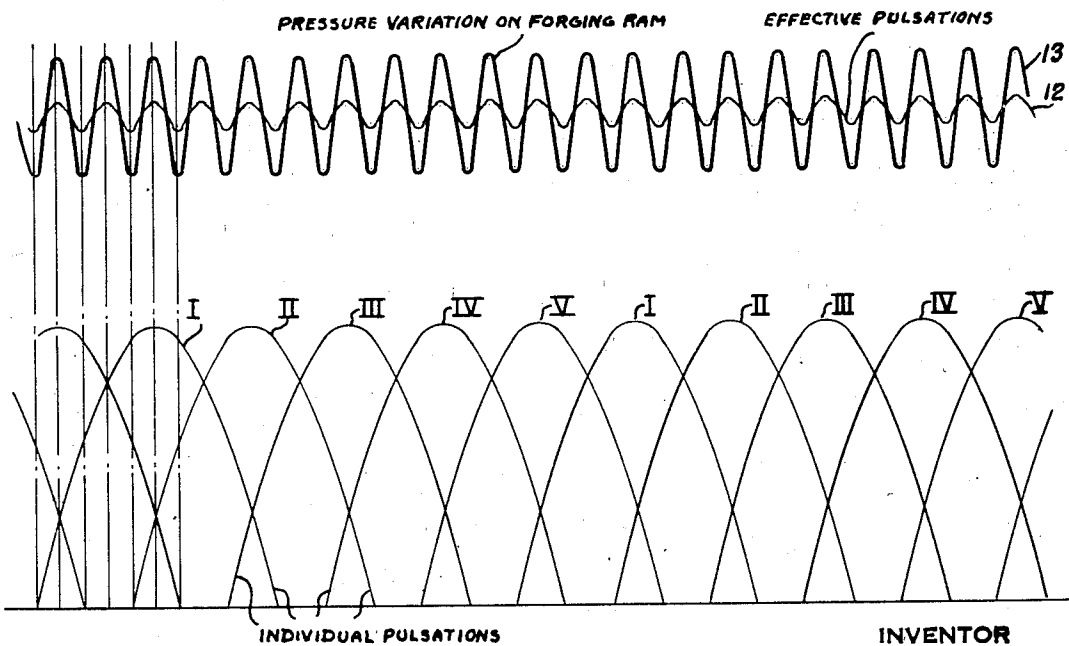


Fig. 2.



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METHOD OF FORGING

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4 Claims. (Cl. 78—81)

This invention relates to forging and, in particular, to an improved method of metal forging.

Heretofore, hot machine forging was carried out either by causing the forging ram to perform a complete cycle for each hammering blow imparted on a billet or by causing the forging ram to forge the billet during a single stroke without hammering the billet.

The first mentioned method was generally carried out by board drop hammers and steam drop hammers, whereas the second method was frequently carried out by mechanical presses, including upsetters.

There is a third group of forging presses, namely, the so-called steam hydraulic presses and the accumulator actuated presses, which are selectively used for causing the ram to perform the forging operation during a single stroke thereof, or to cause the ram to perform a plurality of complete strokes for forging the billet into the desired shape.

Board drop hammers, in which the ram drops by gravity and is lifted by means of a roller actuated board, and also steam drop hammers, in which steam lifts the ram and aids the ram when it drops upon the billet to be forged, have the advantage that they yield a high grade of forging due to the hammering action of the ram. The drawback of these forging presses consists in that the forging ram has to perform a plurality of complete cycles to forge the work piece, which entails relatively much time and high cost of production. Moreover, this type of presses requires a relatively heavy structure.

On the other hand, mechanical presses, including upsetters, which forge a work piece in dies by a single stroke of the forging ram, do not hammer the work piece and, therefore, yield a lower grade of forging, aside from the fact that they have a rather limited field of application.

Referring to the third group of forging presses mentioned above, the ram of a steam hydraulic press is traversed to and from the work by double-acting auxiliary pistons actuated by steam pressure while the main pressing force is generated through a steam actuated hydraulic intensifier. This type of presses likewise yields a lower grade of forging due to the absence of a hammering effect on the work piece and, in addition thereto, requires a relatively complicated and expensive structure.

Finally, accumulator actuated forging presses have the drawback mentioned in connection with steam hydraulic presses and, in addition there-

to, are slow in operation and subject to undesirable shock conditions.

It is, therefore, an object of this invention to provide a forging method, which combines the advantages of the above mentioned forging methods without, however, having the disadvantages thereof.

It is a further object of the invention to provide a hot forging method which will make it possible to forge a work piece during a single cycle of the forging ram while simultaneously subjecting the work piece to a plurality of hammering impulses.

Another object of the invention consists in the provision of a hot forging method according to which the forging is subjected to a series of rapidly applied hydraulic pressure impulses in one and the same direction.

It is still another object of the invention to provide a method of hot forging by rapidly applying a series of hydraulic pressure impulses to the billet, while simultaneously maintaining the pressure on the billet substantially constant during the forging operation.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing, in which:

Figure 1 diagrammatically illustrates the forging method according to the present invention.

Figure 2 graphically illustrates the hydraulic impulses applied to the billet in accordance with the invention.

The essence of the invention consists substantially in applying to the forging ram, and through the latter to the billet, a series of hydraulic pressure impulses while the ram moves in one and the same direction. The pressure impulses may be generated by any kind of pulsation generator.

The supply of pressure fluid from a fluid source to the ram is preferably carried out in a continuous manner, but so that the quantity of fluid being delivered rapidly fluctuates between a minimum and a maximum value. This fluctuation results in a slight hammering effect on the fluid and, thereby, on the ram and billet, which hammering effect is sufficient to yield a higher grade of forging than was heretofore obtainable by the accumulator type forging. On the other hand, due to the rapidity at which the said fluctuation or hydraulic impulses are applied, while the forging ram moves in one and the same direction, the forging time is materially decreased over the forging time heretofore required in connection with steam forging presses.

Referring now to the drawing in detail, Figure 1

illustrates in a diagrammatic manner the forging method according to the invention.

According to Figure 1, a pulsation generator 1, which may be of any desired type for instance a pump with a plurality of pumping plungers, is connected through a conduit 2 with a hydraulic cylinder 3 having reciprocally mounted therein a piston 4 with a piston rod 5.

The piston rod 5 has connected thereto a forging ram 6 adapted to enter a forging die 7 which receives the forging billet 8.

Pressure fluid is supplied by the pulsation generator at very brief intervals through the conduit 2 into the cylinder 3, where it acts on the piston 4, which latter conveys the fluid pressure acting thereupon through the piston rod 5 and forging ram 6 upon the billet 8. The arrows 9, 10 and 11 indicate successive impulses.

Since the hydraulic impulses exerted on the piston 4 are produced in rapid succession, the piston 4, while moving in one and the same direction toward the forging die 7, is subjected to corresponding rapid hammering blows and conveys these blows to the billet.

The hydraulic impulses imparted upon the billet are graphically illustrated in Figure 2, in which it is assumed that the pulsation generator, during one cycle thereof, creates five hydraulic impulses, indicated I, II, III, IV and V.

As will be clear from the lower part of Figure 2, some of the impulses overlap each other. If the ordinates of the various impulses I, II, III, IV and V were added up, the curvature 12 will be obtained, which curvature indicates the fluctuation of the total flow of pressure fluid to the cylinder 3. This fluctuation causes the successive pulsations indicated by the arrows 9, 10 and 11 in Figure 1.

As will also be noted from Figure 2, the number of pulsations of impulses in the cylinder 3 is greater than the number of individual pulsations created by the pulsation generator.

Figure 2 also comprises a further curve 13, which illustrates the pressure variation over the piston 4. According to Figure 2, this pressure variation is in phase with the fluctuation of the total flow of pressure fluid to the cylinder 3.

As will be clear from the above, the speed at which the impulses occur in the cylinder 3 and are imparted through the piston 4 and forging ram 6 upon the billet 8 may be varied by varying the impulses created by the pulsation generator per cycle. In this way the number of impulses, during a given time on the billet, may be varied in accordance with the material of the billet or work piece to be shaped.

The new method according to the invention has proved highly successful and has actually revolutionized the technique of metal working.

For instance, by applying the method according to the invention, it has been made possible to produce the head of a combustion engine not only in record time, but simultaneously to make the head about twice as strong as it was when produced according to methods heretofore in use, although the head forged according to the present method weighs materially less than a corresponding head produced according to the methods heretofore employed.

While the invention has been described in connection with a system in which the pulsation generator and fluid source constitutes one and the same device, it is, of course, understood that the method according to the invention may also be carried out by a system in which the pulsation generator and the fluid source for supplying the pressure fluid are separate units.

It may also be mentioned that, while according to Figure 1 the flow of fluid from the fluid source to the ram cylinder takes place in the same direction in which the pressure pulsations act upon the ram, the pressure pulsations may, if desired, be effected on the work piece or billet to be forged in a direction opposite to the direction in which the pressure fluid acts upon the billet or work piece. In this instance the fluid pressure acting on the billet or work piece may be held at a substantially constant value during the forging operation.

As stated above, the main feature of the present invention consists in rapidly applying hydraulic pressure impulses to the forging, while maintaining a predetermined minimum pressure on the forging.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims and the invention.

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

1. The process of forging consisting of applying a predetermined minimum forging pressure on the work while superimposing a pulsating forging pressure thereon.

2. The process of hot forging consisting of applying a predetermined minimum forging pressure on the work while superimposing a pulsating forging pressure thereon.

3. The process of forging consisting of applying a predetermined minimum hydraulic forging pressure on the work while superimposing a pulsating hydraulic forging pressure thereon.

4. The process of forging consisting of simultaneously hammering and pressing the work to shape.

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