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METHOD OF AND APPARATUS FOR ELECTRICALLY HEATING AND UPSETTING RODS OR BARS

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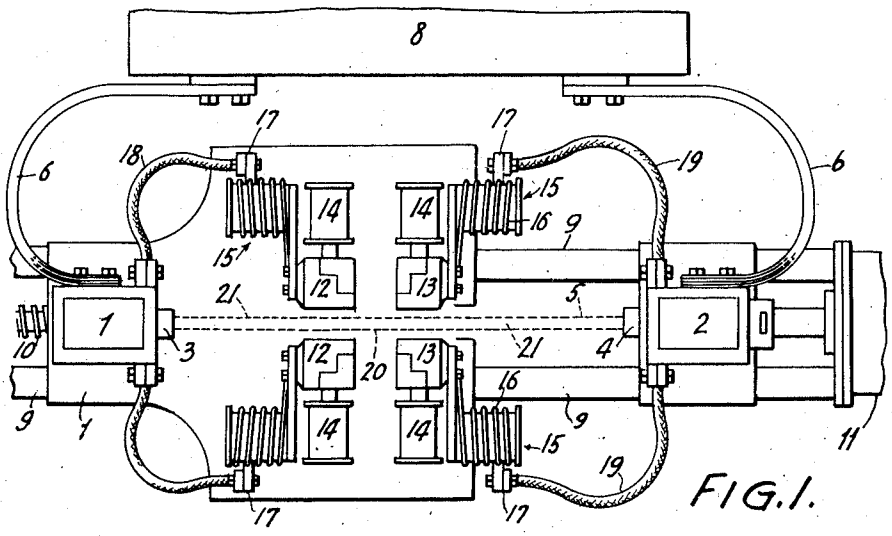


FIG. 1.

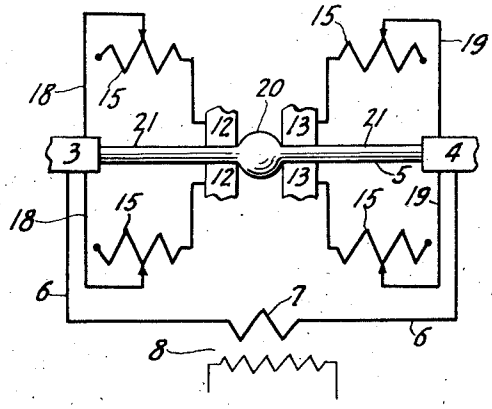


FIG. 2.

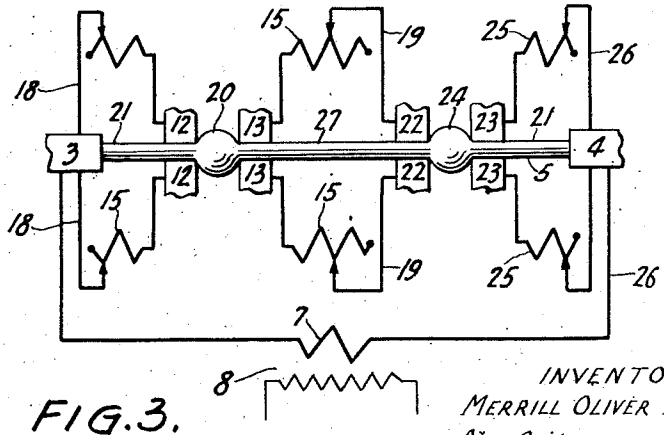


FIG. 3.

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METHOD OF AND APPARATUS FOR ELECTRICALLY HEATING AND UPSETTING RODS OR BARS

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1

This invention relates to the heating and upsetting of metal rods or bars using electric resistance heating and refers particularly to the upsetting of rods or bars at a point centrally or intermediate of the ends. Rods or bars upset in this manner can be used for the manufacture of various articles, such as, for instance, die stocks, spanners, valves, gate bolts and the like.

The invention has for its object the provision of a method and apparatus whereby the central or intermediate portion of the rod or bar required to be upset can be quickly heated to the upsetting temperature while simultaneously therewith the remaining end portions of the rod are subjected to a slow heating and, after the upset has been performed, the entire length of the rod is heated to forging temperature, all by electric resistance heating.

According to the invention, the rod or bar to be operated on is placed between end contacts on head and tail saddles and two pairs of oppositely arranged contacts provided at the sides of the rod are brought into engagement with the rod on opposite sides of the central or intermediate portion to be upset. A heavy current is passed through said central or intermediate portion of the rod between the two pairs of side contacts to quickly heat said central or intermediate portion to upsetting temperature and, when the metal of such portion becomes plastic, one or both of the saddles moves inwardly under applied pressure and causes the metal of said central or intermediate portion to flow or be upset to the required bulbous form.

Simultaneously with the heating and upsetting of the central or intermediate portion of the rod, the remaining end portions of the rod between the end contacts and the side contacts are given a slow heating by causing a portion of the current to leak through said end portions. Finally, the side contacts are withdrawn from engagement with the rod and the full current passed through the rod to heat the entire length of the rod to the temperature required for subsequent forging or shaping.

The contacts of the head and tail saddles are connected to a source of heavy low voltage current, such as the secondary winding of a step-down transformer, and the two pairs of side contacts are connected to the head and tail saddle contacts respectively through bridging conductors in each of which an adjustable resistance or the like is interposed.

When the side contacts are in engagement with

2

the rod, the current passes from the head saddle contact through the bridging conductor and adjustable resistance to one pair of side contacts, then through the central or intermediate portion of the rod to the other pair of side contacts and then through the bridging conductor and adjustable resistance to the tail saddle contact. The resistances partly restrict the flow of current through the bridging conductors so that a portion of the current leaks through the end portions of the rod between the head saddle contact and one pair of side contacts and the other pair of side contacts and the tail saddle contact and so causes the slow heating of said end portions simultaneously with the heating and upsetting of the central or intermediate portion of the rod.

The invention is more fully described aided by reference to the accompanying drawings wherein:

Fig. 1 is a plan view of the preferred form of apparatus used in the invention.

Fig. 2 is a diagram illustrating the electrical arrangements and also showing the central or intermediate portion of the rod in the process of being upset.

Fig. 3 is a diagram illustrating a modification or variation wherein the rod is upset at two intermediate points.

The apparatus as shown in these views comprises a head saddle 1 and a movable tail saddle 2. The head saddle carries a contact 3 while the tail saddle carries a contact 4. The metal rod 5 to be operated on is placed between said contacts 3 and 4 as indicated by the dotted lines in Fig. 1.

The contacts 3 and 4 are connected by flexible conductors 6 to a source of heavy low voltage current such as the secondary winding 7 of a step-down transformer 8.

The head saddle 1 is made adjustable to suit the length of the rod 5 by mounting it on slides 9 and providing a suitable leading screw 10 operated by a hand-wheel or the like (not shown).

The tail saddle 2 is movable to apply the upsetting pressure to the rod 5 and, for this purpose, it is also mounted on the slides 9 and has pressure applied to it by means of the air cylinder 11.

The head saddle 1 carries two pairs of oppositely arranged side contacts 12 and 13 which are moved into and out of contact with the rod 5 by means of air cylinders 14 or the like also carried by the head saddle. The contacts 12 and 13 are spaced apart according to the quan-

tity of metal required to be upset at the central or intermediate portion of the rod and suitable means may be provided for adjusting this distance.

Connected to the side contacts 12 and 13 are adjustable resistances 15 each consisting of a copper coil 16 which may be tubular for water cooling. The coils are tapped as required by means of tapping members 17 connected respectively by flexible bridging conductors 18 and 19 to the head saddle contact 3 and the tail saddle contact 4.

In use, the rod 5 to be upset is placed between and gripped by the end contacts 3 and 4 and the side contacts 12 and 13 moved inwardly into engagement with the rod. The heavy current from the transformer thus passes through the bridging conductors 18 and resistances 15 to the side contacts 12, then through the central or intermediate portion 20 of the rod to the other side contacts 13 and then through the resistances 15 and bridging conductors 19 to the tail saddle contact 4. The central or intermediate portion 20 of the rod is thus rapidly heated to plastic state whereupon the tail saddle 2 moves inwardly under its applied pressure to cause the metal of said heated central or intermediate portion 20 to flow or be upset to bulbous form as shown in Fig. 2.

During this heating and upsetting operation not all of the current is carried by the bridging conductors 18 and 19 but, due to the restriction offered by the resistances 15, portions of the current leaks through the two end portions 21 of the rod between the head saddle contact 3 and the side contacts 12 and between the side contacts 13 and the tail saddle contact 4 and thus gives these portions of the rod a slow heating simultaneously with the heating and upsetting of the central or intermediate portion 20.

On the completion of the upset, the side contacts 12 and 13 are withdrawn from the rod. The full current then passes through the whole length of the rod to heat the entire rod to the requisite temperature for forging or shaping.

By the method of heating described, considerable economy is secured. The slow heating of the end portions 21 of the rod simultaneously with the heating and upsetting of the central portion 20 enables the whole rod to be quickly heated to forging temperature after the upset has been completed and the side contacts 12 and 13 are withdrawn. Moreover, with the continuous sequence in the heating as described, the residual heat in the upset portion 20 of the rod is not dissipated but is retained in the heating of the whole rod to forging temperature.

It will, of course, be obvious that the amount of current allowed to leak through the end portions 21 of the rod can be controlled by adjusting the resistances 15. Thus, the temperature to which the preliminary heating of the end portions 21 of the rod is carried can be conveniently controlled. Likewise, the resistances 15 can be adjusted as required to suit the length and the gauge or diameter of the rod 5 being upset, and other requirements.

Although two bridging conductors with resistances 15 are described herein and shown in the drawings connected to each pair of side contacts 12, 13, it will be appreciated that only single bridging conductors and resistances may be used, although the above dual construction is generally preferred.

It will be obvious that, if the upset portion

20 is to be located at the centre of the finish rod, the distance between the side contacts 13 and the tail saddle contact 4 must be greater than the distance between the side contacts 12 and the head saddle contact 3 to provide the necessary metal to form the upset portion 20. It is possible, however, to avoid this by feeding the rod from both ends. In this construction, the head saddle is also mounted for slidable movement and has pressure applied to it by means of an air cylinder similar to the air cylinder 11. The side contacts 12 and 13 would, in this form, be mounted independently of the head saddle 1. Otherwise the construction of the apparatus is the same.

The invention can also be extended to form two intermediate upset portions on the rod simultaneously, as shown in Fig. 3. In this embodiment, two additional pairs of side contacts 22 and 23 are provided to heat the second portion 24 of the rod to be upset and the bridging conductors 19 from the side contacts 13 are connected to the side contacts 22 while additional adjustable resistances 25 are provided connected to the side contacts 23. These resistances are connected by bridging conductors 26 to the tail saddle contact 4.

The operation of this form of apparatus is the same as that previously described, portion of the current leading through the end portions 21 and also the central portion 27 to slow heat the latter when the intermediate portions 20 and 24 are being heated and upset. Both the head and the tail saddles would, in this form, be arranged to move inwardly under applied pressure to feed the rod from both ends.

It is also possible to form more than two upset portions simultaneously by extending the invention further in similar manner to the form above described.

What I claim is:

1. In the heating and upsetting of metal rods or bars using electric resistance heating, the method which consists in placing the rod between end contacts on head and tail saddles, moving two pairs of side contacts into engagement with the rod on opposite sides of a central or intermediate portion, passing electrical current through the central or intermediate portion between said pairs of side contacts to heat the metal of said central or intermediate portion to plastic state, moving at least one of the saddles inwardly under applied pressure to cause the plastic metal to flow or be upset to bulbous form, simultaneously giving the remaining end portions of the rod between the end contacts and the side contacts a slow heating by causing a portion of the current to leak through said end portions while the central or intermediate portion is being heated and upset, and finally withdrawing the side contacts from engagement with the rod to allow the full current to pass through the whole length of the rod to heat the entire rod.

2. An apparatus for heating and upsetting metal rods or bars using electric resistance heating comprising a head saddle and a tail saddle, each having a contact between which the rod is placed, two pairs of side contacts adapted to engage the rod on opposite sides of a central or intermediate portion, means for moving said side contacts into engagement with the rod and out of engagement with the rod, means for passing electrical current through the central or intermediate portion of the rod between said pairs of side contacts while the latter are engaged with

the rod to heat said central or intermediate portion to upsetting temperature, means for moving one or both of the saddles inwardly to cause the metal of the heated central or intermediate portion to flow or be upset to bulbous form, and means causing a portion of the current to leak through the remaining end portions of the rod to give such portions a slow heating simultaneously with the heating and upsetting of the central or intermediate portion the withdrawal of said side contacts causing the full current to pass through the whole length of the rod.

3. An apparatus as claimed in claim 2 wherein the contacts of the head saddle and tail saddle are connected to a source of electrical current, said two pairs of side contacts being connected to the head and tail saddle contacts respectively through bridging conductors and an adjustable resistance in each bridging conductor, the restriction offered by the resistances causing a portion of the current to leak through the end portions of the rod between the end contacts and the side contacts to give such portions of the rod the slow heating simultaneously with the heating and upsetting of the central or intermediate portion.

4. An apparatus as claimed in claim 3 and means to form additional intermediate upset portions on the rod simultaneously, said last named means comprising two additional pairs of side contacts for each additional upset portion and additional bridging conductors and resistances substantially duplicating the side contacts, bridging conductors and resistances of said first mentioned upset portion.

5. In the heating and upsetting of metal rods or bars using electric resistance heating, the method which consists in placing the rod between end contacts on head and tail saddles, moving two pairs of side contacts into engagement with the rod on opposite sides of a central or intermediate portion, passing electrical current through the central or intermediate portion between said pairs of side contacts to heat the metal of said central or intermediate portion to plastic state, moving at least one of the saddles inwardly under applied pressure to cause the plastic metal to flow or be upset to bulbous form, and finally withdrawing the side contacts from engagement with the rod to allow the full current to pass through the whole length of the rod to heat the entire rod.

6. An apparatus for heating and upsetting metal rods or bars using electric resistance heating comprising a head saddle and a tail saddle, each having a contact between which the rod is

placed, said contacts being connected to a source of electrical current, two pairs of side contacts adapted to engage the rod on opposite sides of a central or intermediate portion, means for moving said side contacts into and out of engagement with the rod and means for passing electrical current through the central or intermediate portion of the rod between said pairs of side contacts while the latter are engaged with the rod to heat said central or intermediate portion to upsetting temperature, and means for moving at least one of the saddles inwardly to cause the metal of the heated central or intermediate portion to flow or be upset to bulbous form, the disengagement of said side contacts causing the full current to pass through the whole length of the rod.

7. An apparatus as claimed in claim 6, wherein said two pairs of side contacts are connected to the head and tail saddle contacts respectively through bridging conductors and an adjustable resistance in each bridging conductor.

8. An apparatus for heating and upsetting metal rods or bars using electric resistance heating comprising a head saddle and a tail saddle, each having a contact between which the rod is placed, two pairs of side contacts adapted to engage the rod on opposite sides of a central or intermediate portion, means for moving said side contacts into engagement with the rod and out of engagement with the rod, means for passing electrical current through the central or intermediate portion of the rod between said pairs of side contacts while the latter are engaged with the rod to heat said central or intermediate portion to upsetting temperature, means for moving at least one of the saddles inwardly to cause the metal of the heated central or intermediate portion to flow or be upset to bulbous form, and means causing a portion of the current to leak through the remaining end portions of the rod to give such portions a slow heating simultaneously with the heating and upsetting of the central or intermediate portion.

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