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3,478,565

FORGING MACHINE

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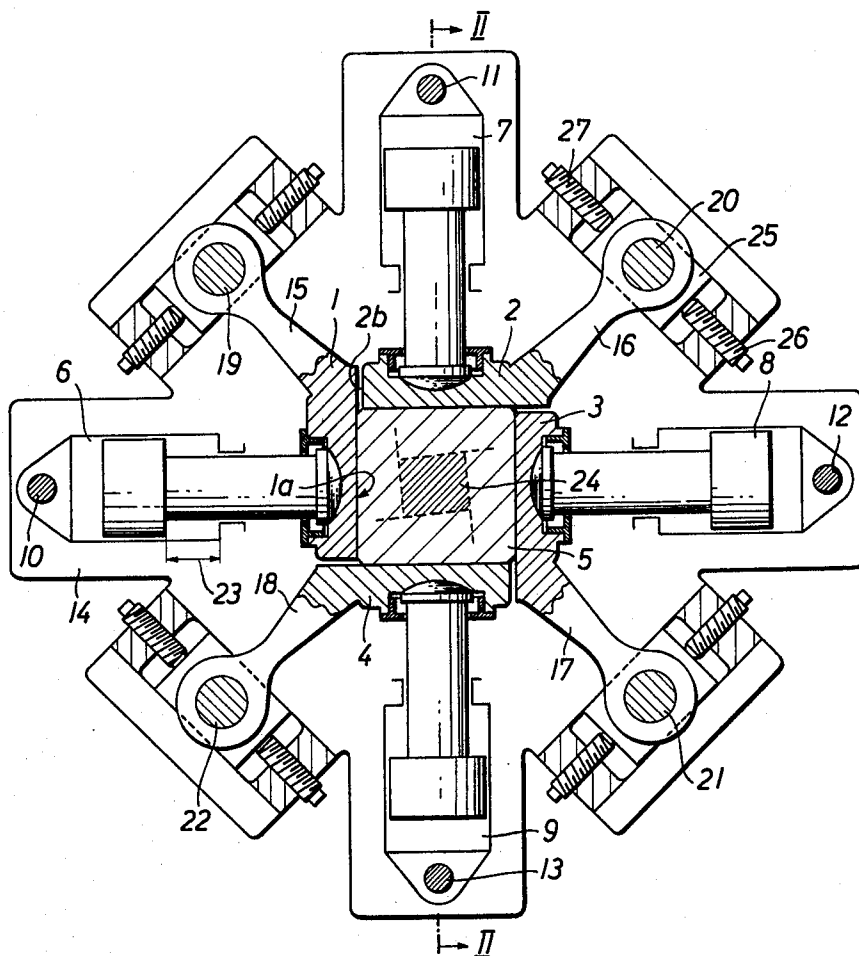


FIG. 1

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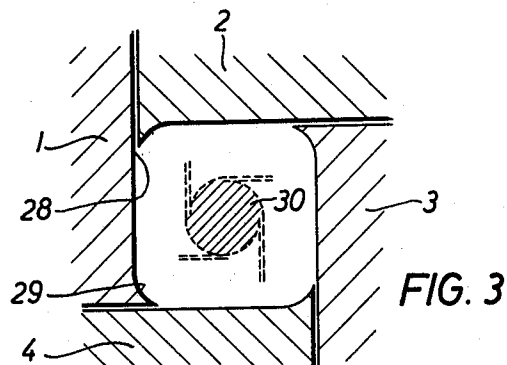
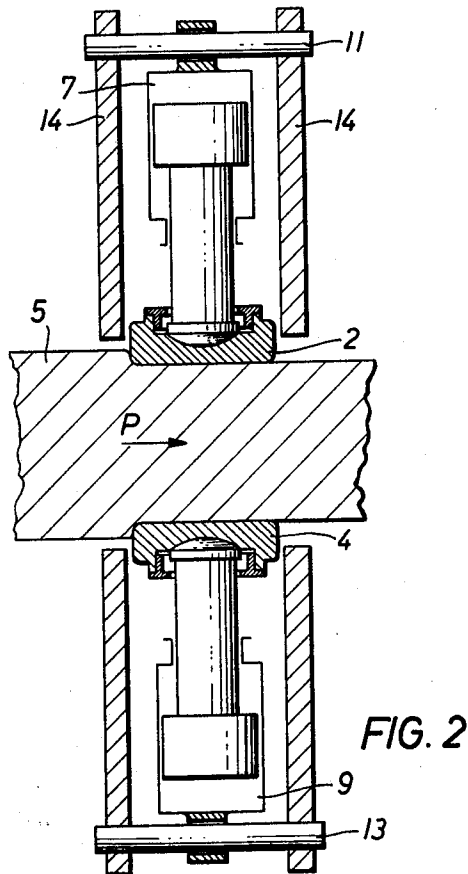
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FORGING MACHINE

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4 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to forging machines with at least three forging saddles pivoted on a fixed frame and each having an end face and a pressure face which bears against a workpiece. An hydraulic ram acts on each saddle to move it inwards against the workpiece, the pivots constraining the saddles to move so that the end face of each saddle is substantially in contact with the pressure face of a neighbouring saddle to maintain a substantially closed throat around the workpiece.

In the working of blocks of steel or other metals to form bar stock, if the cross-section of the final bar is large it can be uneconomical to roll the material and in this case forging hammers, forging presses or forging machines are used. In contrast to forging hammers and forging presses, which operate with only two forging saddles, forging machines usually have four or more saddles, which enclose the workpiece as completely as possible during the forging operation.

Many highly alloyed materials are apt to be cracked by the tensile stresses which arise during hot working. This disadvantage would be overcome by deforming the material by laterally applied pressure, the workpiece being contained in a fully enclosed throat in a forging machine. However in previously known forging machines, the four or more forging saddles either do not form between them a fully enclosed throat, or do so only towards the end of the deformation process. For this reason this method of working is inferior, in regard to the flow effects produced, to rollers which completely surround a work piece while reducing its area of cross section.

In accordance with the present invention a forging machine has at least three forging saddles which are arranged to surround a workpiece in use and, by moving inwards towards each other, reduce the cross sectional area of the workpiece, each saddle having a pressure face to bear against the workpiece, an end face and a guide which constrains the saddle to maintain its end face substantially in contact with the pressure face of a neighboring saddle as the saddles move inwards towards each other in use. In this way a fully enclosed throat is maintained throughout the deformation process.

Preferably each of the guides, constraining the saddles to maintain their end faces substantially in contact with the pressure faces of neighbouring saddles, comprises an arm rigidly fixed to the respective saddle, from which it extends obliquely relatively to the direction of movement of the saddle, and pivoted on a fixed part of the machine. Apart from the constructional simplicity of such guides, there is the further advantage that the cross-sectional shape of the forged bar can be easily and conveniently changed. For this purpose, each of the arms may be pivoted about a pin which is adjustable in position relative to the fixed part of the machine in a direction perpendicular to its axis. For example when it is desired to produce bar of rectangular cross-section, the ratio between the sides and ends of the rectangle can be altered by adjusting the posi-

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tions of two oppositely situated pivot pins, leaving the other two pivot pins where they are. On the other hand, if all the pivot pins are adjusted in position simultaneously, the shape of the cross-section of the bar produced will be unchanged.

A machine according to the invention is capable of forging not only bar of triangular, rectangular or polygonal cross-section, but also if desired round bar. For this purpose it is merely necessary that the pressure face of each saddle should have a flat portion and, adjacent to the end of the saddle, a part cylindrical portion. The radius of the round bar produced is then equal to the radius of curvature of the cylindrical portions of the working faces of the saddles.

For driving the individual forging saddles, hydraulic rams are preferred each ram having a piston and a cylinder, the cylinders being pivoted on a fixed part of the machine at their outer ends to allow the pistons to follow the movements of the saddles.

One forging machine in accordance with the invention is illustrated in the accompanying drawings, in which:

FIGURE 1 is a cross-section through the machine; FIGURE 2 is a view with parts in section taken on the line II-II in FIGURE 1; and,

FIGURE 3 is a cross-section corresponding to FIGURE 1; of the forging saddles and the workpiece of a modification of the machine.

The drawings illustrate only those parts which are necessary for explaining the invention. Other parts, for example the means for advancing the workpiece, have been omitted for the sake of simplicity. The machine represented in FIGURES 1 and 2 is for making rod material of rectangular cross-section. However, from the explanation given below it is obvious that by using other numbers of forging saddles other polygonal cross-sections can be made. However there must be at least three forging saddles.

The machine shown in FIGURES 1 and 2 has four forging saddles 1, 2, 3 and 4, positioned at 90° to each other and enclosing a workpiece 5. Each forging saddle rests not only with a pressure face in contact with the workpiece 5, but also with an end face in contact with a neighbouring forging saddle. For example, in FIGURE 1 there is contact between the pressure face 1a of the saddle 1 and the end face 2b of the saddle 2. The same applies to all the other saddles.

Each saddle is driven by a hydraulic piston in a cylinder together forming a ram. The cylinders are shown at 6, 7, 8, 9, and are pivoted at 10, 11, 12, 13 on a fixed frame 14 of the machine. As soon as hydraulic pressure is applied, each piston pushes its saddle towards the middle of the machine, and between them they squash the workpiece 5. The movement of each saddle is guided by one of four arms 15, 16, 17, 18. Each arm pivots about one of four pins 19, 20, 21, 22. The axis of each pin runs at right angles to the plane of the drawing in FIGURE 1, and parallel to the direction of the arrow P in FIGURE 2, the arrow P representing the direction of advance of the workpiece. Each of the arms 15, 16, 17, 18 extends at an angle to the direction of thrust of the saddle during deformation of the workpiece. If, as shown, there are four saddles and the machine is producing bar of square cross-section, the angle between each arm and its saddle pressure surface is preferably 45°.

After the four pistons of the four cylinders 6, 7, 8 and 9 have all performed working strokes of the same length, the workpiece 5 has been squashed to a smaller but still square cross-section, as shown by a small hatched square 24 in FIGURE 1. During this squashing operation the axis of the square has become slightly displaced from its original position. Furthermore the final square cross-

section is slightly rotated relative to the initial square cross-section. These changes are however not a disadvantage in practice.

After each working stroke the pistons withdraw, and the workpiece 5 is advanced in the direction of the arrow P by an amount equal to the width of the saddles. The forging process taking place here is usually hot forging.

The position of each of the pivot pins 19, 20, 21, 22 of the saddle arms 15, 16, 17, 18 is adjustable in position by means of sliding blocks and adjustment screws, the direction of adjustment being at right angles to the length of the arm. FIGURE 1 shows the sliding block for the pivot pin 20 of the arm 16 at 25, and the adjustment screws for this block at 26 and 27. By adjusting the positions of the pivot pins in this way, the cross-sectional shape of the forged workpiece can be changed. For example, if it is desired to produce bar of rectangular cross-section, instead of square section bar as shown in FIGURE 1, then the opposite pivot pins 20 and 22 are both adjusted in the same sense, that is to say either both clockwise or both anti-clockwise about the workpiece 5, the pivot pins 19 and 21 remaining unchanged in position. If desired the rectangular cross-section of the forging can be made still longer and thinner by also adjusting the positions of the pivot pins 19 and 21, this time both in the sense opposite to the adjustment of the pins 20 and 22, for example if the pins 20 and 22 are shifted clockwise as seen in FIGURE 1, then the pins 19 and 21 are shifted anti-clockwise. It will be observed that the cross-sectional shape produced in the forging is unchanged if all the pivot pins are shifted in the same sense, for example all clockwise or all anti-clockwise.

FIGURE 3 shows a saddle shape suitable for forging a round bar. For the sake of simplicity there are here again four saddles 1, 2, 3 and 4. In FIGURE 3 the drives and saddle arms have been omitted, because they are as shown in FIGURES 1 and 2. However, in FIGURE 3 the saddles have pressure surfaces which are not flat all the way. Each pressure surface consists of a flat part 28 and a part 29 which has a cylindrical curvature. Nevertheless here again the pressure surface of each saddle, or at least the flat part of the pressure surface, rests in contact with the end surface of a neighbouring saddle.

The radius of the cylindrical surface 29 is equal to the radius of the finally forged round bar 30. It will be observed from FIGURE 3 that the four saddles cannot be entirely crowded together, as can the saddles in FIGURE 1 and 2, but can be brought together only far enough to forge a bar of round section of the same radius as the curves 29.

In the case of a hydraulically driven forging machine the four driving cylinders 6, 7, 8, 9 can be fed with hydraulic fluid by four separate pumps, each delivering the same precisely metered volume of fluid. Alternatively

the hydraulic drive can be a conventional equal-action hydraulic drive. On the other hand, if desired there can be used instead of a hydraulic drive a mechanical drive, for example by means of cranks or rods. Finally, although it is possible to guide the saddles 1, 2, 3, 4 by means other than the arms 15, 16, 17, 18, these arms are a particularly simple means for guiding the saddles and have the special advantage that the cross-section of the forging can be changed by adjusting the positions of the pivot pins.

We claim:

1. A forging machine comprising a fixed frame having an axis along which a workpiece is disposable, at least three forging saddles, each of said forging saddles having an end face and a pressure face, said pressure faces defining a throat adapted to receive the workpiece therein, separate means for moving each of said saddles relatively to said frame inwards to constrict said throat, and means movably mounting said saddles on said frame and adapted to constrain said movement of said saddles so that said end face of each of said saddles is maintained substantially in contact with said pressure face of a neighboring one of said saddles during said inward movement, said means for mounting said saddles on said frame comprising a guiding arm integral with and projecting from each of said saddles at an oblique angle to the direction of said movement of said saddle and pivoting means connecting a portion of each of said arms remote from said saddle to said frame, said pivoting means having an axis about which said arms are pivotable, said pivot axis extending parallel to the axis of said forging machine frame.

2. A forging machine according to claim 1, wherein each of said pivoting means includes a pivot pin and means for adjusting the position of said pivot pin relatively to said fixed frame in a direction perpendicular to the axis of said pivot pin.

3. A forging machine according to claim 1, wherein said pressure face of each of said saddles is formed with a flat portion and a cylindrical portion, said cylindrical portion being disposed adjacent said end faces.

4. A forging machine according to claim 1, wherein said saddle moving means comprises an hydraulic ram for each of said saddles, one end of said ram being pivoted on said fixed frame, and the other end of said ram being connected to said saddle.

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RONALD D. GREFE, Primary Examiner