(19) Europäisches Patentamt
European Patent Office
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(11) **EP 1 955 790 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.08.2008 Bulletin 2008/33

(51) Int Cl.:
B21J 5/08 *(2006.01)*

(21) Application number: **07425069.7**

(22) Date of filing: **06.02.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

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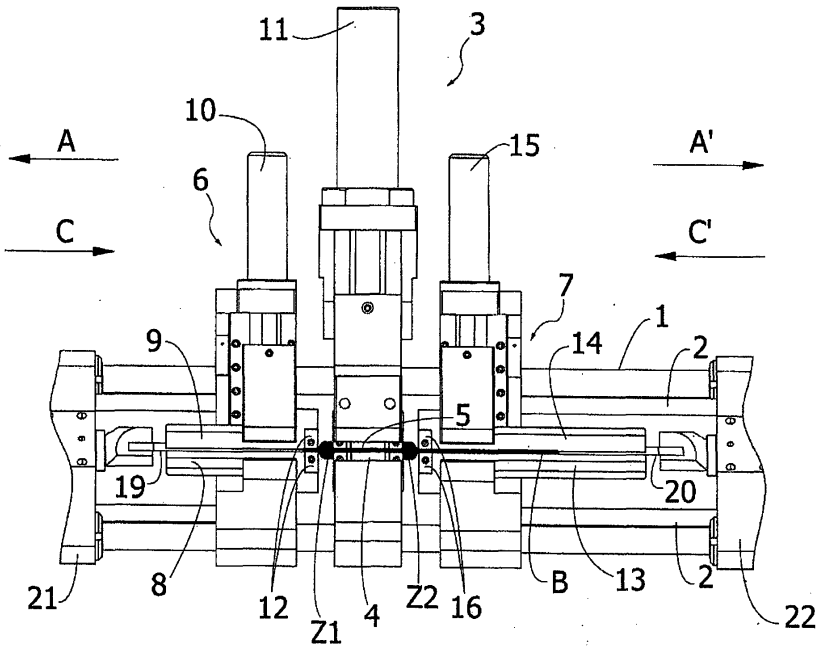
(54) **Electric upsetting method and apparatus**

(57) Two simultaneous electric-upsetting cycles, independent as regards volume, length, and temperature, are performed simultaneously on a metal strap (B) by means of a first stationary-electrode clamp (3) and a second electrode clamp and a third electrode clamp (6, 7), said latter two electrode clamps being set on opposite sides with respect to the first electrode clamp (3). Two thrust devices (19, 20) apply controlled pressures at the opposite ends of the metal strap (B) so as to carry out upsetting of its areas (Z1, Z2) heated by the Joule effect between the first electrode clamp (3) and, respectively, the second and third electrode clamps (6, 7), whilst the latter are moved away at a controlled rate from the first electrode clamp (3), displacing in a direction opposite to the thrust exerted, respectively, by the first thrust device (19) and by the second thrust device (20).

FIG. 7



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Description

Background of the invention

[0001] The present invention relates to processes of electric upsetting, i.e., of hot plastic deformation by means of which localized increments of the transverse dimensions of a metal piece are obtained, by accordingly reducing the length thereof.

[0002] More in particular the invention relates to a method and a machine for the electric upsetting of metal strap, particularly, albeit not exclusively, for the production of forged knives, for example with dimensions in the region of 4x60x600 mm or 3x30x400 mm.

State of the prior art

[0003] Current electric-upsetting machines for forming metal bars typically comprise a stationary-electrode clamp and a mobile-electrode clamp, between which the metal bar is to be positioned and heated, by the Joule effect, in its area comprised between said clamps. A thrust device applies a thrust upon one end of the bar, whilst the mobile-electrode clamp moves away from the stationary-electrode clamp in a direction concordant with that of the thrust device.

[0004] This arrangement evidently enables performance of a single upsetting operation. In some applications, typically in the case of forged cutlery, the metal strap must be subjected to a second electric upsetting to form a second upset area: this requires the use of a second machine provided for said purpose, or at least repositioning of the metal strap in the same electric-upsetting machine, in this case re-programmed for the second operation.

Summary of the invention

[0005] The purpose of the present invention is to provide a method and a machine for electric upsetting of metal strap that will enable simultaneous formation of two contiguous upsetting operations, which are altogether independent of one another in terms of volume, length, and also temperature of the two upset areas.

[0006] According to the invention, this purpose is achieved thanks to a method of electric upsetting, as defined in its most general terms in Claim 1, and to an electric-upsetting machine, as defined in Claim 3.

Brief description of the drawings

[0007] The invention will now be described in detail with reference to the annexed plate of drawings, which are provided purely by of way of non-limiting example and in which:

- Figure 1 is a plan view of an example of metal strap prior to an operation of electric upsetting that can be obtained via the invention;
- Figure 2 is a side elevation of Figure 1;
- Figure 3 is a view similar to that of Figure 1 that illustrates the metal strap subsequent to the operations of electric upsetting;
- Figure 4 is a schematic front elevation of an electric-upsetting machine according to the invention, represented in an initial step of the electric-upsetting cycle; and
- Figures 5 to 8 are views similar to that of Figure 4 that show the subsequent steps of the electric-upsetting cycle according to the invention.

Detailed description of the invention

[0008] Figures 1 and 2 show, by way of example, a metal strap B, designed for the production of a forged knife and having, for example, dimensions in the region of 4x60x600 mm or 3x30x400 mm.

[0009] The method and the machine according to the invention enable, via two simultaneous but independent electric-upsetting cycles, increase in the transverse dimensions of the metal strap B in an area corresponding to two areas Z1, Z2, by accordingly reducing the length thereof, in the way represented in Figure 3.

[0010] With reference to Figure 4, the electric-upsetting machine according to the invention basically comprises a horizontal supporting structure 1 bearing a longitudinal guide 2 that extends on opposite sides with respect to a stationary central body, designated as a whole by 3.

[0011] The central body 3 consists in an electrode clamp including a fixed bottom element 4 and a mobile top element 5 displaceable vertically with respect to the fixed bottom element 4, for example via a fluid actuator 11, between a raised, inoperative, position (represented in Figures 4 and 8) and a lowered, operative, position (represented in Figures 5, 6 and 7).

[0012] On opposite sides of the central body 3, the supporting structure 1 bears a first mobile body 6 and a second mobile body 7, each of which is displaceable at a controlled rate, via a respective motor-driven system (not illustrated in so far as it is within the reach of any person skilled in the branch), along the guide 2, with the modalities described in what follows.

[0013] The first mobile body 6 also consists in an electrode clamp, with a vertically fixed bottom element 8 and a vertically mobile top element 9, which is displaceable, via an actuator, for example, a fluid actuator 10, between a raised, inoperative, position (represented in Figures 4 and 8) and a lowered, operative, position (represented in Figures 5-7).

[0014] On the side facing the central body 3, the bottom and top elements 8, 9 of the first mobile body 6 bear a first upsetting apparatus, designated as a whole by 12, facing a corresponding upsetting apparatus of the central body 3.

[0015] The second mobile body 7 has a conformation

specularly similar to that of the first mobile body 6, with an electrode clamp formed by a vertically fixed bottom element 13 and a vertically mobile top element 14, which is also displaceable, for example, via a fluid actuator 15, between a raised, inoperative, position (represented in Figures 4 and 8) and a lowered, operative, position (represented in Figures 5-7), with the modalities also described in what follows. The ends of the fixed and mobile elements 13, 14 facing the fixed body 3 in turn bear a second upsetting apparatus, designated as a whole by 16 and facing a corresponding upsetting apparatus of the central body 3.

[0016] The electrode clamps 8-9 of the first mobile body 6 and 13-14 of the second mobile body 7 define respective electrical sliding contacts designed to cooperate with those of the electrode clamp defined by the elements 4-5 of the central body 3. Said contacts may conveniently be supplied in a separate way, via respective autonomous and independent transformers, designated as a whole by 17, 18 in Figure 4.

[0017] Designated by 19 and 20 are two pushers situated on opposite sides with respect to the assembly that is constituted by the bodies 3, 6 and 7 and is displaceable horizontally, in the direction of the guide 2 and, via respective motor-driven thrust carriages 21, 22, between the retracted position, represented in Figures 4 and 8, and progressively advanced positions, represented in Figures 5, 6 and 7, at a controlled pressure, with the modalities also clarified in what follows.

[0018] The various motor-driven actuators of the components described above are connected to a programmable electronic unit (not illustrated) for control of the simultaneous double electric-upsetting cycle, hereinafter described with reference to the metal strap B of Figures 1 and 2.

[0019] As has already been clarified previously, said metal strap B can, for example, constitute the starting element for the production of forged knives equipped with two "nodes", one between the blade and the handle and the other at the end of the handle, designated, respectively, by Z1 and Z2 in Figure 3.

[0020] In the first step of the electric-upsetting cycle represented in Figure 4, the metal strap B is positioned through the bodies 3, 6 and 7 in a horizontal condition of resting on the corresponding stationary bottom elements 4, 8 and 13. The metal strap B may be provided with a position reference, for example constituted by a chamfer, to enable precise positioning thereof. In this step, the mobile elements 5, 9 and 14 are kept in the raised, inoperative, position.

[0021] In the subsequent step, represented in Figure 5, the mobile elements 5, 9 and 14 of the bodies 3, 6 and 7 are displaced, via the respective actuators 11, 10 and 15, into the lowered, operative, position. In this way, the corresponding electrode clamps are arranged in electrical sliding contact, at a controlled pressure, with the metal strap B. At the same time, the pushers 19 and 20 are brought up, via the respective thrust carriages 21 and 22, to the opposite ends of the metal strap B, moving in the directions indicated by the arrows C and C' in Figures 5 to 7.

[0022] Then, the electrode clamps of the mobile bodies 6 and 7 are electrically supplied via the respective transformers 17 and 18, in such a way as to heat by the Joule effect the portions of the metal strap B comprised, respectively, between the upsetting apparatus 12 of the mobile body 6 and the one corresponding to the fixed body 3 on one side, and between the upsetting apparatus 16 of the mobile body 7 and the one corresponding to the fixed body 3 on the other. When said areas reach the temperature of incandescence, the pushers 19 and 20 are further moved, at a controlled pressure, in the direction indicated by the arrows C and C', whilst simultaneously the mobile bodies 6 and 7 are displaced at a controlled rate in the direction of the arrows A and A', moving progressively away from the central body 3, in the way represented in Figures 6 and 7. In this way, the volume of the incandescent areas of the bar in contact with the apparatuses 12 and 16 increases progressively until the two enlarged portions or nodes Z1, Z2, corresponding to the final configuration of the metal strap B represented in Figure 3, are generated.

[0023] The electrode clamps 8-9 of the first mobile body 6 and 13-14 of the second mobile body 7 consequently effect displacement in the working step, moving with respect to the fixed body 3 in a direction contrary to the thrust devices 19 and 20, respectively.

[0024] At the end (Figure 8), heating of the metal strap B is interrupted, the pushers 19 and 20 are brought back rapidly into the retracted starting position, and the mobile elements 5, 9 and 14 of the bodies 3, 6 and 7 are brought back into the raised starting position, to enable extraction of the upset metal strap B.

[0025] It will appear evident from the foregoing description that the method and the machine according to the invention advantageously enable two simultaneous electric-upsetting cycles to be carried out with restricted distances between centres (for example, in the region of 80-100 mm) and independent of one another as regards volumes, lengths and temperatures, an advantage that enables an appreciable reduction in the times of production of electrically upset metal strap, in particular for the production of forged knives, mechanical components, etc.

[0026] Of course, the details of construction and the embodiments may vary widely with respect to what is described and illustrated herein, without thereby departing from the scope of the present invention, as defined by the ensuing claims.

Claims

1. A method of electric upsetting of metal strap, **characterized in that** it comprises the steps of positioning a metal strap (B) in electrical contact between a

first electrode clamp (3) and a second electrode clamp and a third electrode clamp (6, 7), which are set on opposite sides to said first electrode clamp (3) for delimiting with the latter a first area of heating and a second area of heating (Z1, Z2) of the metal strap (B), heating by the Joule effect said metal strap (B) in an area corresponding to said first area of heating and second area of heating (Z1, Z2) via said electrode clamps (3, 6, 7), and applying a first controlled thrust and a second controlled thrust at the opposite ends of the metal strap (B) so as to carry out simultaneous upsetting of said first and second areas of heating (Z1, Z2) against said first electrode clamp (3) whilst said second and third electrode clamps (6, 7) are moved at a controlled rate with respect to said first electrode clamp (3) in a direction opposite to the thrust exerted, respectively, by said first thrust device (19) and said second thrust device (20).

2. The method of electric upsetting according to Claim 1, **characterized in that** said second electrode clamp (6) and said third electrode clamp (7) are supplied electrically in an independent way.

3. An electric-upsetting machine for forming metal strap, **characterized in that** it comprises a supporting structure (1) bearing a first electrode clamp (3), a second electrode clamp (6), and a third electrode clamp (7), which can be opened and re-closed and between which a metal strap (B) is to be positioned and heated by the Joule effect, in which said first electrode clamp (3) is stationary and said second and third electrode clamps (6, 7) are set on opposite sides of said first electrode clamp (3) for delimiting with the latter a first area of heating (Z1) and a second area of heating (Z2) of the metal strap (B) and can be displaced along said support (1) in the longitudinal direction of the metal strap (B), and a first thrust device (19) and a second thrust device (20) for applying respective opposed controlled thrusts at the ends of said metal strap (B) so as to press it in its longitudinal direction against said first electrode clamp (3), through said second and said third electrode clamps (6), for carrying out simultaneous upsetting of said first and second areas of heating (Z1, Z2) against said first electrode clamp (3), whilst said second and third electrode clamps (6, 7) are moved at a controlled rate with respect to said first electrode clamp (3) displacing in a direction opposite to the thrust exerted, respectively, by said first thrust device (19) and by said second thrust device (20).

4. The electric-upsetting machine according to Claim 3, **characterized in that** said second electrode clamp (6) and said third electrode clamp (7) are supplied electrically by respective independent transformers (17,18).

FIG. 1

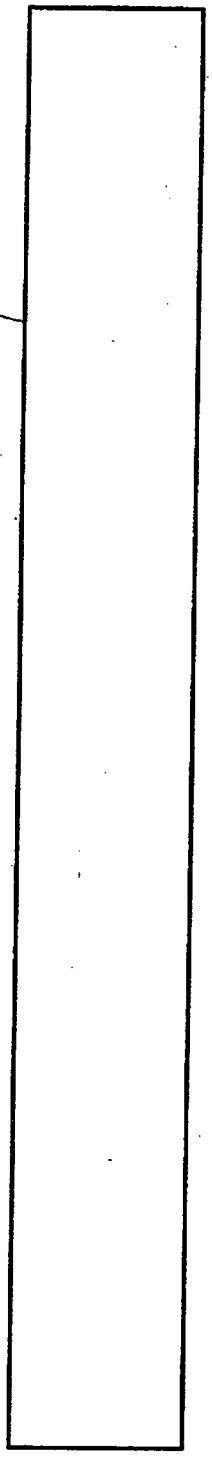


FIG. 2

FIG. 3

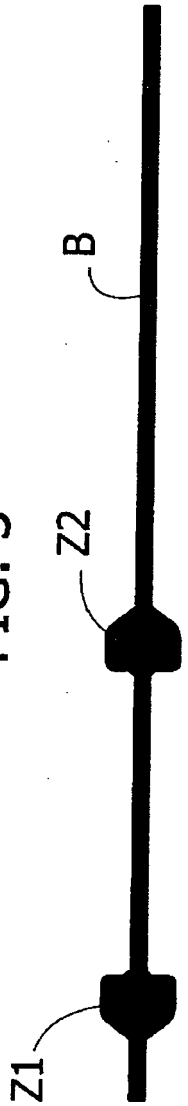


FIG. 4

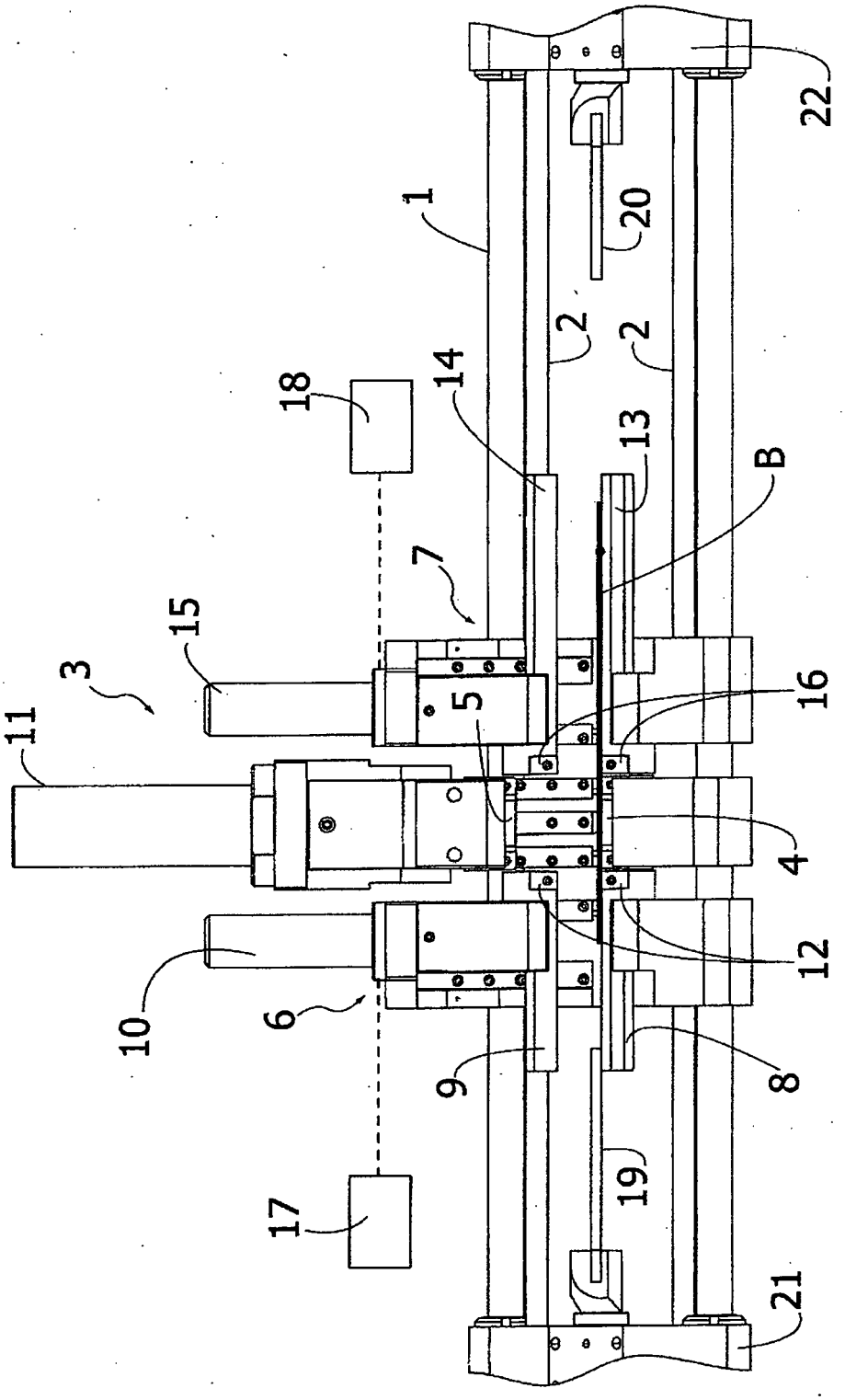


FIG. 5

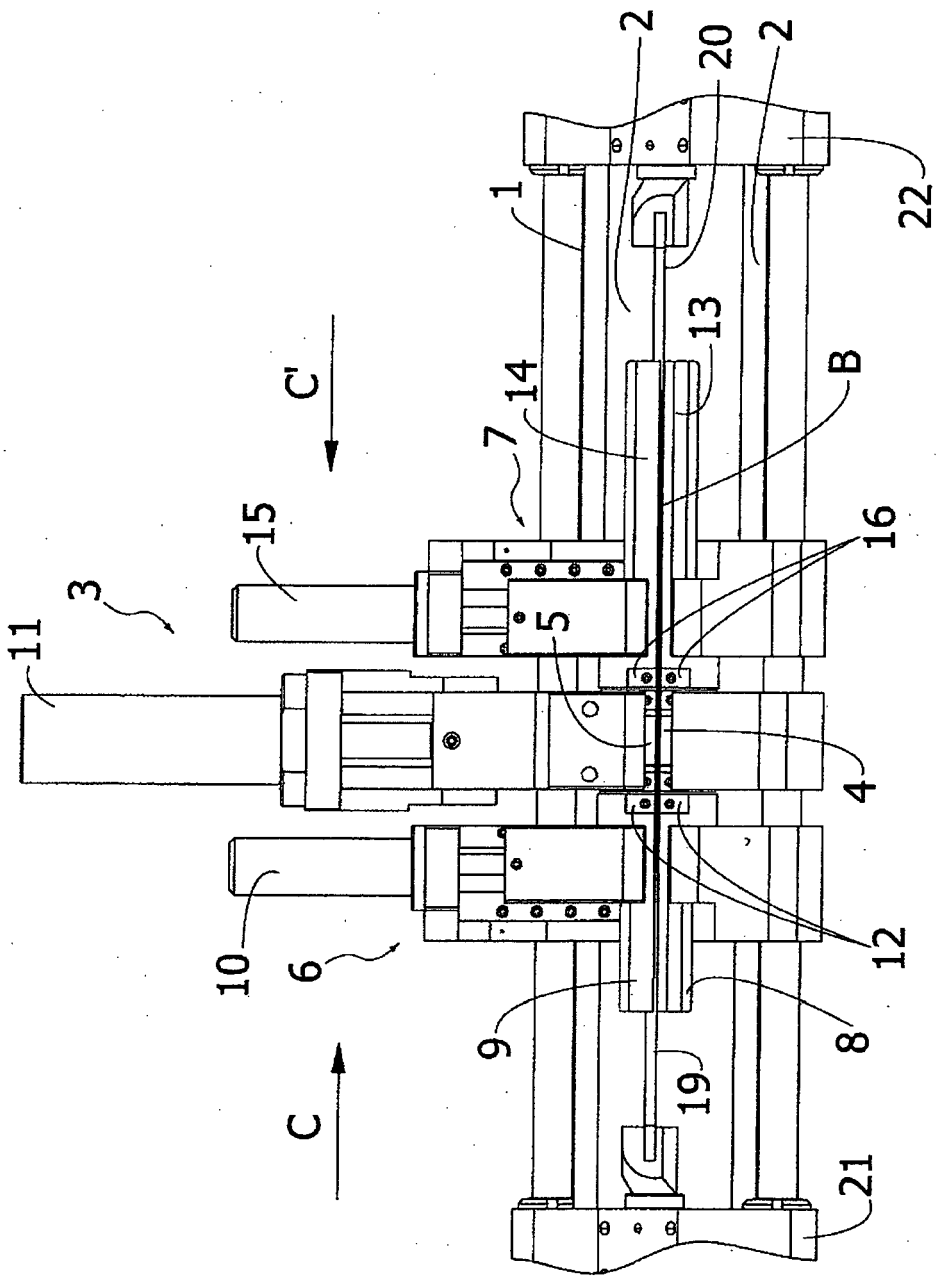


FIG. 6

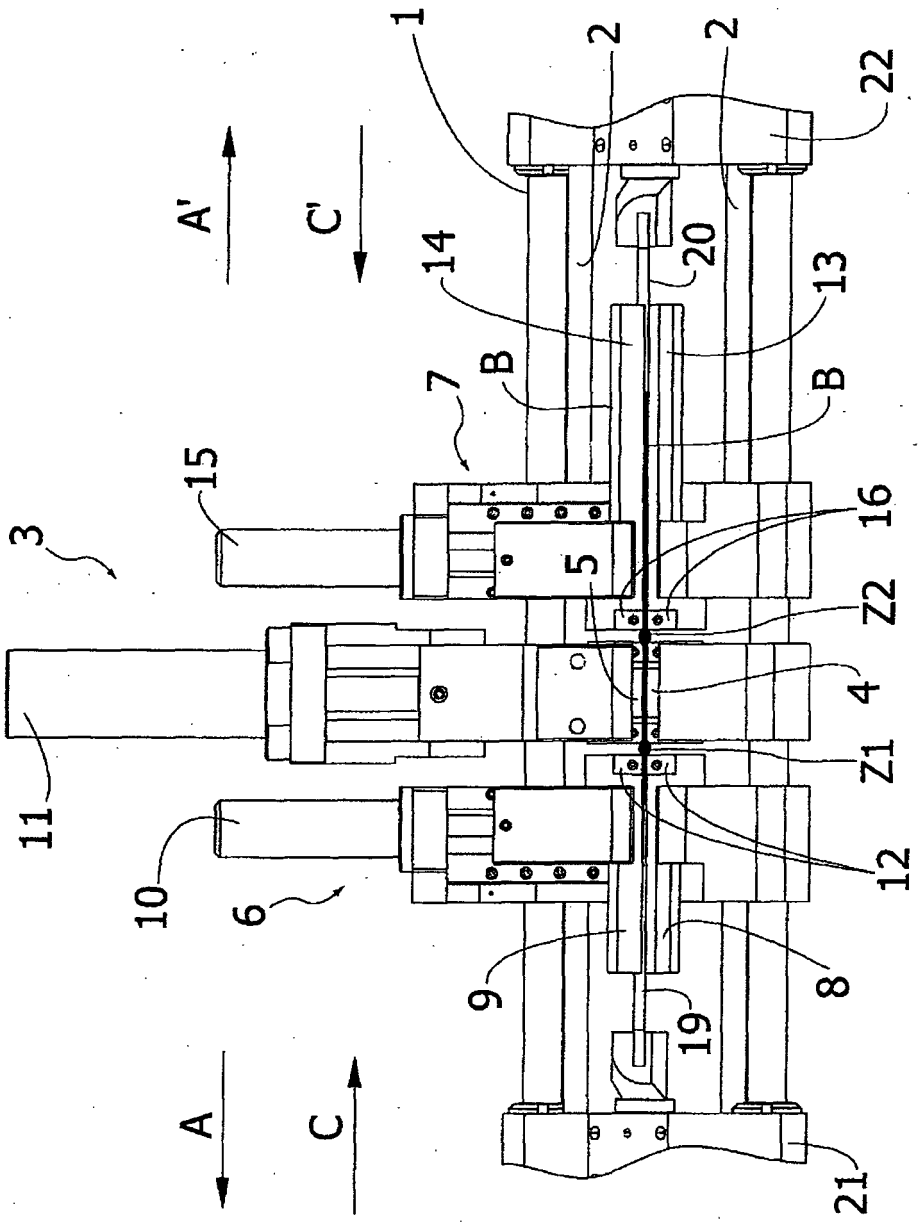


FIG. 7

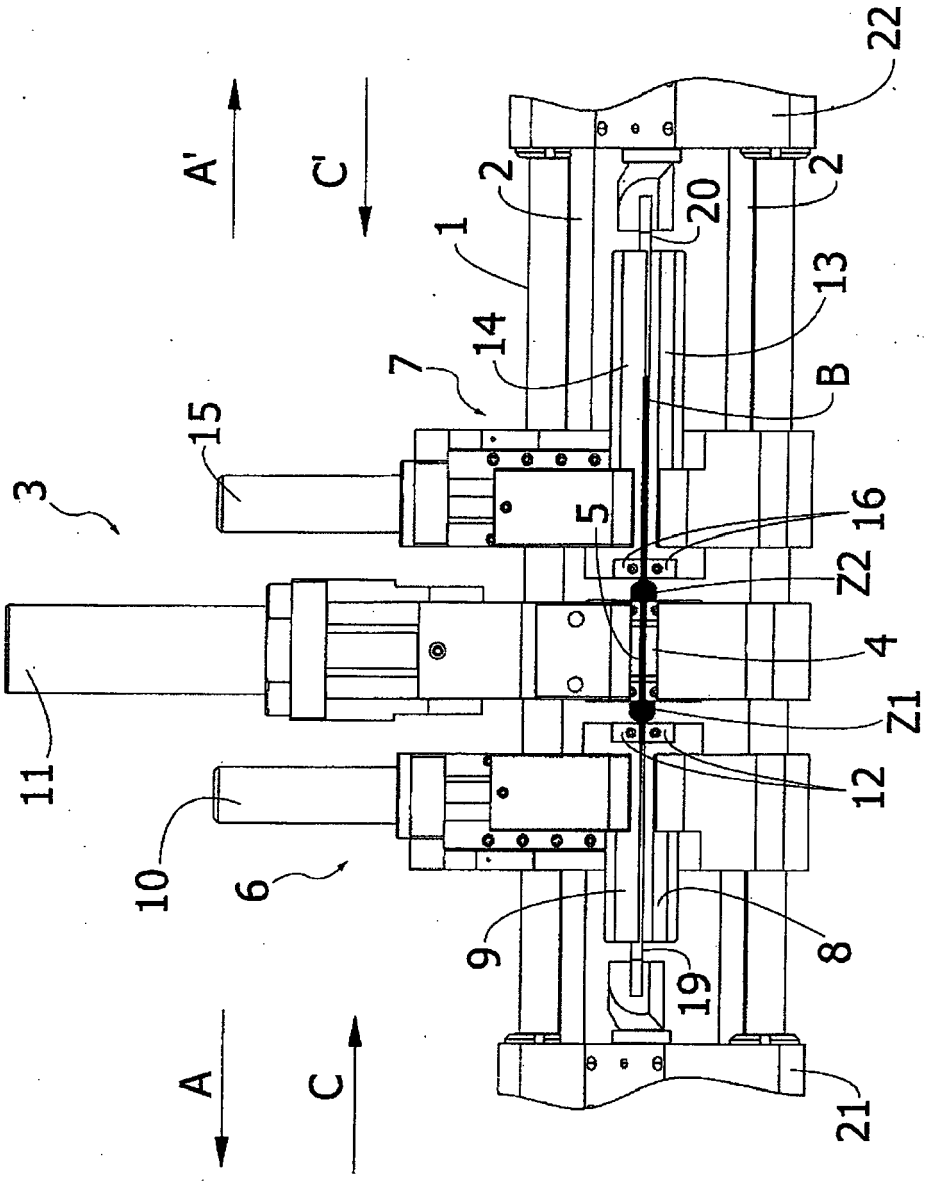
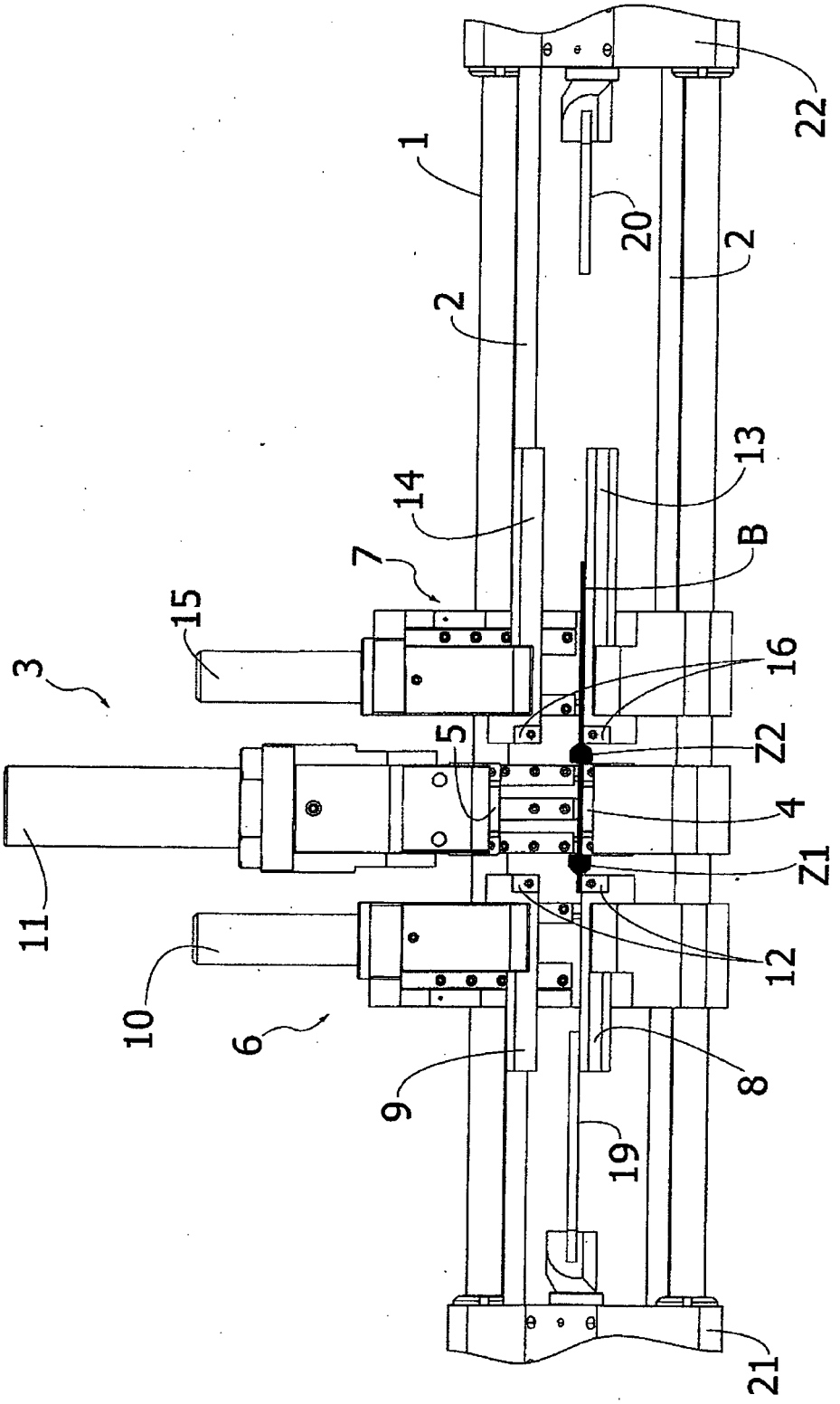


FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 07 42 5069

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	EP 0 667 196 A (ELECTROFORGE IND S A [FR]) 16 August 1995 (1995-08-16) * column 2, line 48 - column 3, line 25 * * column 4, line 55 - column 5, line 5 * * figures 1,9 * -----	1-4	
A	US 2006/254338 A1 (OTAKI ATSUSHI [JP]) 16 November 2006 (2006-11-16) * paragraphs [0318] - [0326] * * paragraphs [0382] - [0390]; figure 10 * -----	1,3	

TECHNICAL FIELDS SEARCHED (IPC)

B21J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 June 2007	Augé, Marc

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06-06-2007

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