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(54) Apparatus for producing an outer body for the head of a ball joint

(57) Apparatus (1) for producing a outer body (2) for ball joint, the said outer body (2) comprising an upper part (3) in the form of a head and a lower part (4) in the form of a leg; the apparatus (1) comprising

- a cutting station for producing substantially cylindrical metal workpieces;
- at least one cold forming station (10) in which the initial workpiece is shaped with two cylindrical parts (3, 4);
- at least one cold forming station (20, 30) in which the part (3) having the larger diameter is formed with four sides (6a, 6a, 6b, 6b) in pairs parallel to one another;
- at least one cold shaping station (40, 50) acting to confer on the part (3) a curvilinear form having two sides (6b, 6b) and an enlarged flat shape on the remaining two sides (6a, 6a)
- means for displacing the workpiece;
- a control unit (11).

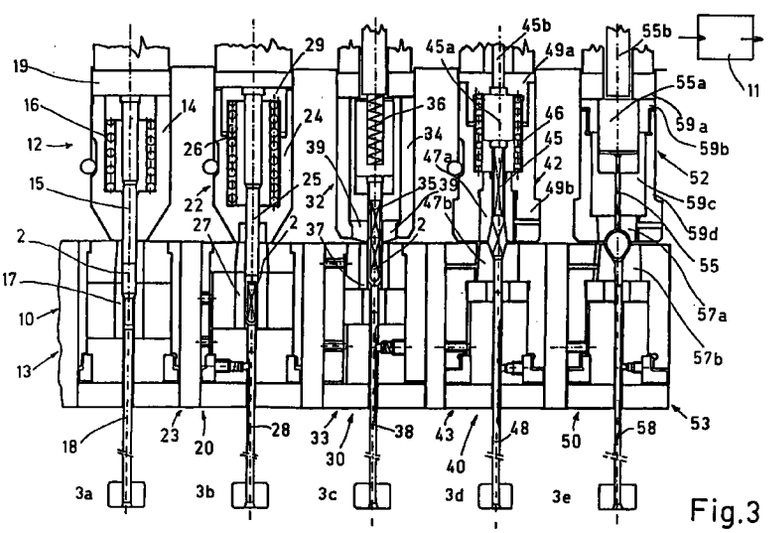

Fig.3

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Description

The present invention relates to apparatus for producing an outer body for the head of a ball joint.

The head of a ball joint (in accordance with the DIN 648 K regulations) generally comprises an outer body which can be connected to an associated control rod and is provided at one end with a cylindrical seat, and a ball which can be connected to a further rod and is coupled to the body by means of the interposition of a bush of anti friction material positively engaging the seat itself.

For a detailed description of the head of a ball joint of this type reference is made to Italian patent application B093A000265, in the name of the same applicant.

Normally outer bodies of this type are obtained by machining to remove material, starting from a steel bar of 9SMnPb28 steel, or are hot stamped.

Removal of material by machining in particular, however, involves extremely high production costs which are of a significance which cannot be ignored. In fact, during removal of material by machining a significant quantity of material remains unused in that it constitutes the swarf or cutting chips, the subsequent recovery of which is extremely onerous. Moreover, the above-described manner of production involves the use of a significant number of machine tools grouped in work units (islands) which, as well as being relatively expensive in themselves, involve operating and maintenance costs which are not insignificant and which increase the unit cost of the ball joint significantly.

The present invention essentially consists in a series of arrangements which, although individually known, together confer on the apparatus in question a high level of reliability which makes it possible for it to be completely automated. Among other things the elements obtained by means of the present apparatus are absolutely free from working defects such as internal cracks, fractures etc. Finally, the outer bodies obtained by means of the apparatus which forms the subject of the present invention have a decidedly lower unit production cost than those produced with conventional machining or hot stamping systems.

The present invention relates to an apparatus for the production of an outer body for the head of a ball joint, this outer body comprising an upper part in the form of a head and a lower part in the form of a leg.

The apparatus comprising the subject of the present invention is characterised in that it comprises

- a cutting station for producing substantially cylindrical metal blanks;
- at least one cold forming station in which the initial blank is shaped with two cylindrical parts one superimposed over the other having different diameters;
- at least one cold forming station in which on a first part having the larger diameter four sides in parallel pairs are formed;
- at least one cold shaping station acting to confer on this first part a curvilinear form having two sides and an enlarged flat form to the remaining two sides;
- means for displacing the blank to and from the cutting station, the cold forming stations and the cold shaping station; and
- a control unit for controlling the operations.

The invention will now be described with reference to the attached drawings which illustrate a non-limitative embodiment thereof, in which:

- Figure 1 is a schematic view of an apparatus for the production of an outer body for the head of a ball joint;
- Figure 2 illustrates in section the various configurations assumed by the workpiece to obtain the finished workpiece (Figure 2e);
- Figure 3 illustrates in section the various cold forming stations which constitutes the apparatus shown in Figure 1.

As shown in Figures 1 to 3 the apparatus 1 forming the subject of the present invention comprises a series of working stations 10-50 in which the various working stages take place at the end of which the initial blank will assume the configuration shown in Figure 2e which represents the finished element 2.

For clarity it should be said that in the following detailed description of the invention the reference numeral 2 will be used both to indicate the metal blank in the various working phases and the finished element.

The various stations 10-50 are driven and controlled by an electronic central control unit 11 which also controls the loading and unloading operations of the metal blanks to and from the stations 10-50 by means not shown in the attached drawings.

The station 10, in particular, at which the initial blank (not shown) is converted to the configuration of Figure 2a, is constituted by an upper punch unit 12 and a lower die unit 13. The punch unit 12 in turn comprises a main body 14 with which an upper punch 15 is slidably engaged. The system could also operate without the main body 14 by utilising only the punch 15, but it is preferred to add this element to increase the safety of operators who are close to the apparatus 1. In fact, a punch 15 could cause the formation of splinters due to breakages on its outer surface; such splinters, because of the strong compression loads in play, could acquire a considerable kinetic energy and strike those in attendance with force. A single actuator (not shown in the drawing) effects the movement of the punch block 12 and the punch 15 to and from the underlying die block 13.

The upper punch 15 fixed to the element 19 and the main body 14 are held apart from one another by the action of a spring 16 which constrains the punch 15 to

remain within the main body 14. The entire upper punch unit 12 presses the element 2 into the die 17 during its downward motion. At this point, upon continuing the pressure, the individual punch 15 is lowered whilst the main body 14 does not proceed further because it is in contact with the lower die unit 13. In the die cavity 17 a first cold deformation of the initial blank takes place in such a way that it assumes the form shown in Figure 2a. as can be established from observation of this Figure, the element 2 has an upper part 3 and a lower part 4, both cylindrical, separated by a shoulder 5. The upper part 3 is a cylindrical body which has a greater diameter than the lower part 4.

The lower pin or plug 18, driven by an actuator serves only as an extractor for the element 2 from the die 17 once the first cold forming operation is completed and does not take part directly in the forming operation. During extraction of the element 2 from the die 17 the whole upper punch unit 12 is raised by the action produced on it by the actuator in such a way that the element 2, moved by the lower pin 18, is located in the free space lying between the punch unit 12 and the die unit 13. At this point pincer means (not shown) act to displace the element 2 from the first station 10 to the second station 20.

In Figure 3b the second station 20 is shown where a further cold working of the material takes place.

The same or similar elements as those shown in Figure 3a have been indicated with the same reference numerals replacing number 1 with number 2.

As usual a single actuator (not shown) effects the movement of the entire punch unit 22. In this case, too, the punch 25 is held within the main body 24 by the effect of the spring 26. The punch unit 22 is therefore responsible for the introduction of the element 2 into the seat provided in the die 27 fixed to the die unit 23. By continuing the pressure the punch 25 continues to descend drawing the element 2 in the die 27. The mainbody 24, like the main body 24 at the station 10, simply serves to protect the operator from possible metal splinters which can form on the outer surface of the punch 25 during drawing.

The die 27 is shaped in such a way as to confer on the element 2 the shape represented in Figure 2b. Therefore in the die 27 there is provided a seat with a first upper cylindrical portion which acts as an entry region for the substantially cylindrical blank coming from the station 10, and a second lower portion of rectangular section where the forming of the four flat surfaces 6a, 6a, 6b, 6b take place in pairs parallel to one another (Figure 2b). Because of the first upper cylindrical portion of the seat in which the drawing of the blank takes place, a region 7 of cylindrical shape remains on the upper part 3, which will have to be removed in a subsequent operation (see below). Moreover, to avoid unwanted bulging of the workpiece being worked, this workpiece must be completely contained in the seat provided in the die 27. In this case the lower pin 28 also has the primary function of extraction of the element 2 which is displaced immediately afterwards into the subsequent station 30 by pincer means not shown. The operation of extraction of the element 2 from the station 20 is therefore similar to that performed at station 10. In Figures 3c, 3d, 3e the first reference number of each element has also been replaced with the numbers 3, 4, 5 respectively.

In Figure 3c the elimination of the region 7 from the part 3 takes place. The first operation to perform is that of pressing the element 2 into the die 37 in such a way that only the cylindrical end 7 projects from it.

This pressing operation is achieved by the punch 35. In the upper punch unit 32 of the station 30 are provided four cutters 39 (of which only two can be seen on Figure 2c). Fixed to the main body 34, these cutters 39 are suitable for longitudinal cutting of the region 7 in such a way that the sides 6a, 6a, 6b, 6b continue up to the upper free end of the element 2 (Figure 2). In this case two separate actuators (not shown) are provided for the movement for the entire punch unit 32 and the punch 34. Upon commencement of the operations the punch 35, having a rectangular section and responsible for the introduction of the element 2 into the die 37, projects downwardly with respect to the cutters 39. During the advancement of the punch unit 32 the spring 36 yields in such a way that the four cutters 39 can affect four longitudinal cuts on the region 7 removing the corresponding waste. Immediately afterwards the punch 35 is spaced from the element 2 by the cutters 39 by means of a lowering movement induced by its own actuator.

The extraction of the element 2 from the die 37 takes place on the other hand by means of the action of the pin 38 driven by an associated actuator (not shown). In other words, whilst the main body 34 begins to rise by the effect of a first actuator, the punch 35 separates the element 2 from the cutters 39 by means of a positive expulsion effected by the associated actuator. When the main body 34 is sufficiently spaced the lower pin 38 comes into operation and starts to press the element 2 upwardly. Once the element 2 is lying between the punch unit 32 and the die unit 33 suitably provided pincer means can grip the element 2 and transport it to the subsequent station.

At the station 40 a preliminary shaping takes place. As is seen in Figure 2d the upper portion 3 of the element 2 and the shoulder 5 have been pressed down further in such a way as to give rise to the portions 3a, 3b. In this case, an upper half die 47a fixed to the punch unit 42 and a lower half die 47b fixed to the die unit 43 are used to form the two portions 3a, 3b. Portions 3a and 3b are joined to one another along the line 8.

The station 40 includes, as is usual, a movable upper punch unit 42 and a fixed lower die unit 43. In the punch unit it is possible to distinguish a first body 9a and a second body 49b separate from one another and subjected to a separating action performed by the spring

46. On the body 49a rests the element 45a fixed to the upper punch 45 and to the rod 45b which is moved by an actuator not shown.

As in the other stations 10, 20, 30 the die unit 43 includes a pin 48 (driven by an actuator not shown) which can slide within the above-mentioned lower half die 47b to effect extraction of the element 2 once the cold pressing/upsetting has been completed.

At the beginning of the operations the entire punch unit 42 is in a raised position by the action of the associated actuator; the body 49a is, in turn, separated from the body 49b thanks to the action of the spring 46. The punch 45 is also raised and located within the body 49b. The element 2 is therefore carried by the pincer means in the space lying between the punch unit 42 and the die unit 43. In the meantime the punch unit 42 starts to lower and to press the element 2 into the lower half die 47b by means of the punch 45. Once the punch unit 42 is resting on the die unit 43, by continuing to press downwardly the spring 46 is also compressed. The body 49a, acting on the element 45a causes the punch 45 to translate downwardly which starts to act on the upper end of the element 2. In this way the part 3 of the element 2 starts to expand laterally to give rise to a head having the form represented in Figure 2d, with the upper part 3 of the element 2 transformed into the sum of the two portions 3a, 3b.

At the end of this forming operation the punch unit 42 is again raised by the first actuator, whilst the punch 45 continues to be pressed downwardly by a second actuator so that the element 2 can be separated from the upper half mould 47a.

At the station 50 the last cold forming operation is performed such as to shape the head of the element 2 as shown in Figure 2e, that is to say with the portions 3a, 3b transformed into the respective portions 3c, 3d which take an essentially half-disc form.

As usual the lower die unit 53 comprises a lower half-die 57b in an extraction pin 58 driven by an actuator (not shown) which can slide freely. The punch unit 52, in turn, comprises four bodies 59a, 59b, 59c, 59d fixed together, and an upper half die 57a retained by the bodies 59c, 59d. The pin 55 driven by the associated actuator via the element 55a and the rod 55b effects separation of the upper half die 57a after the forming phase. The element 2 is finally extracted from the half die 57b immediately afterwards by means of the pin 58.

The function of the station 50 is similar to that of the preceding station. In fact, when the punch unit 52, driven by a first actuator, is fully lowered the upper half die 57a presses the element 2 into the lower half die 57b. Contained pressure causes deformation of the head of the element, which is shaped as shown in Figure 2e by the plastic deformation contemporaneously performed by the half dies 57a and 57b.

The cold stamping operations are concluded at this point, the punch unit 52 can be raised by the first actuator, whilst a second actuator, as mentioned, presses the pin 55 downwardly to effect separation of the element 2 from the upper half die 57a. As in the other stations, the extraction from below of the half die 57b is performed by the pin 58.

The element 2 is finally ready to be subjected to further operations such as, for example, piercing the upper part 3, threading of the lower part 4, heat treatment etc.

Claims

1. Apparatus (1) for producing an outer element (2) for a ball joint, the said outer element (2) comprising an upper part (3) in the form of a head and a ower part (4) in the form of a leg; the apparatus (1) being characterised in that it comprises

   - a cutting station to provide substantially cylindrical blanks of metal;
   - at least one cold forming station (10) in which the initial workpiece is shaped to have two cylindrical parts (3, 4) one superimposed over the other and of different diameters;
   - at least one cold forming station (20, 30) in which the said part (3) having the greater diameter is formed with four sides (6a, 6a, 6b, 6b) in pairs parallel to one another;
   - at least one cold shaping station (40, 50) acting to confer on the said part (3), a curvilinear form having two sides (6b, 6b) and a flat enlarged form on the remaining two sides (6a, 6a);
   - means for displacing the workpiece to and from the said cutting station, the said cold forming stations (10, 20, 30) and the said at least one cold shaping station (40, 50); and
   - a control unit (11) for controlling the operations.

2. Apparatus (1) as claimed in Claim 1, in which there are at least two cold forming stations (20, 30) at which first a rough shaping of the said sides (6a, 6a, 6b, 6b) is performed by drawing the said workpiece in a suitable stamp (27), followed by cutting, by means of a blade (39) of a waste region (7) left over by the preceding operation.

3. Apparatus (1) as claimed in Claim 1, in which the two punches (15, 25) belonging respectively to the two stations (10, 20) are located within respective protective bodies (14, 24).

4. Apparatus (1) as claimed in Claim 1, in which at least one shaping station (40, 50) is provided with an upper half die (47a) with which the associated punch (45) acting to deform the part (3) of the workpiece is slidably associated.

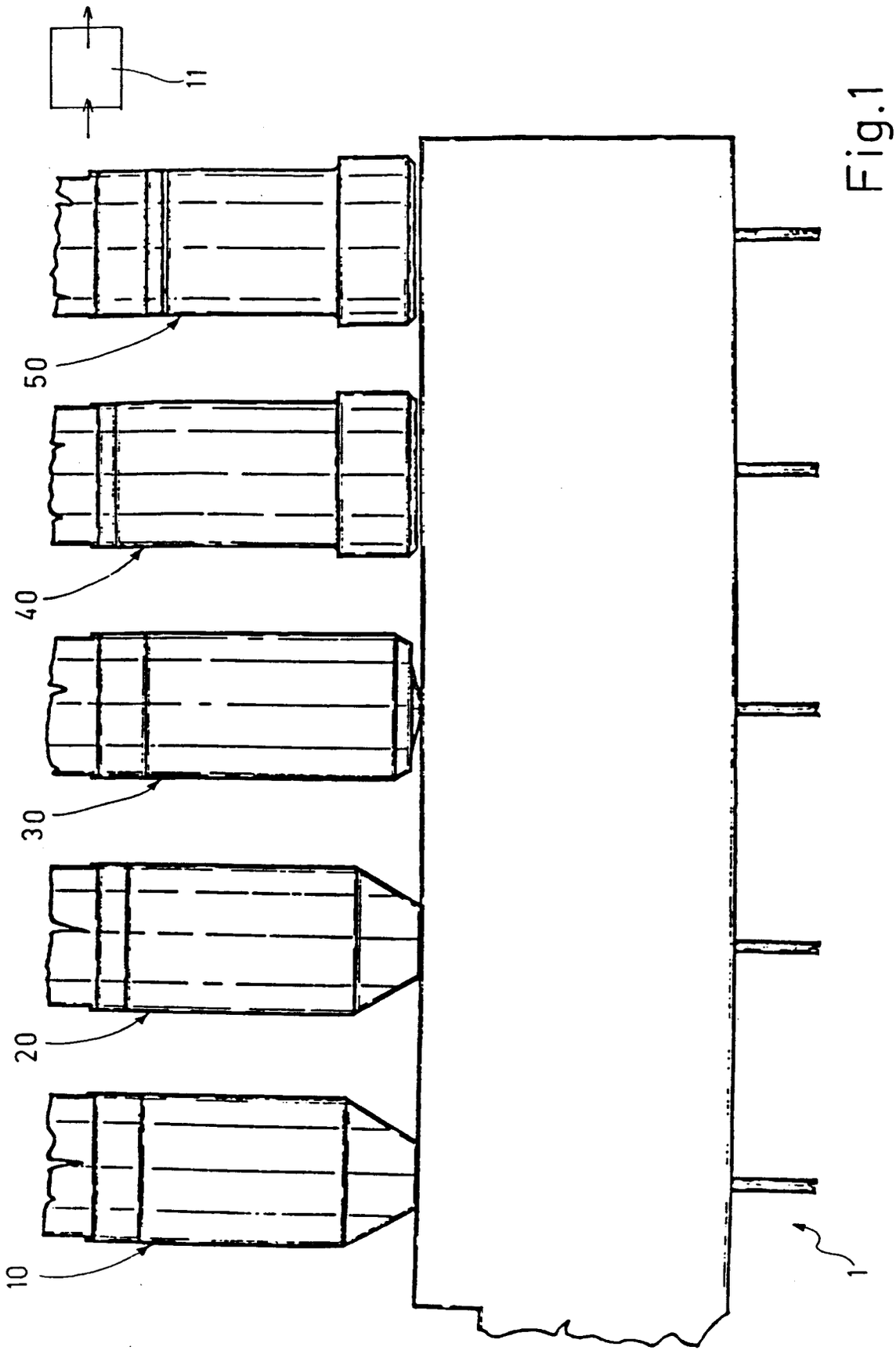
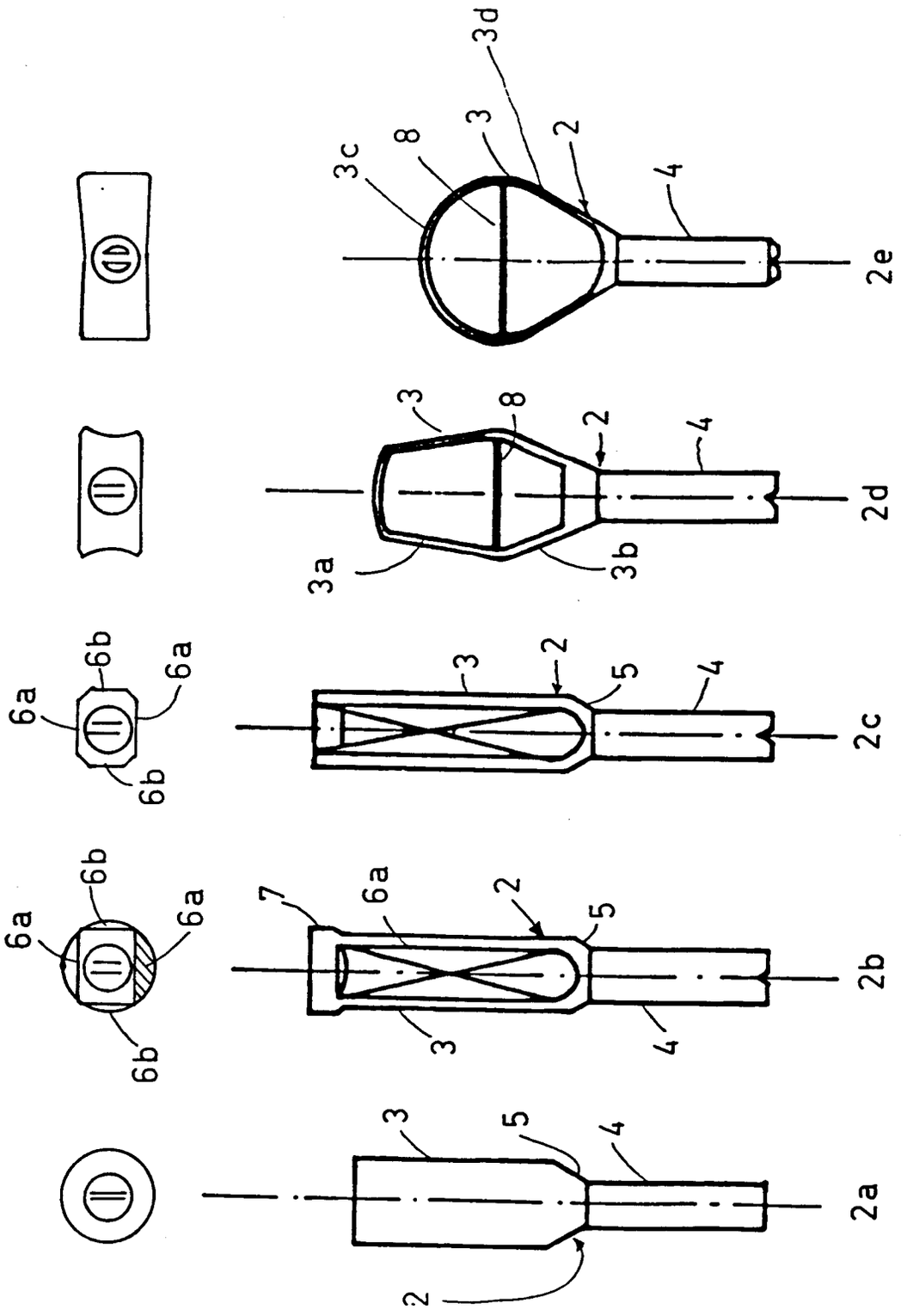


Fig.1


3d
3
2
4
3c
8
2e
3
8
2
4
3a
3b
2d
6b
6a
6a
6b
3
2
5
4
2c
6b
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6a
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4
2b
3
5
4
2
2a

Fig.2

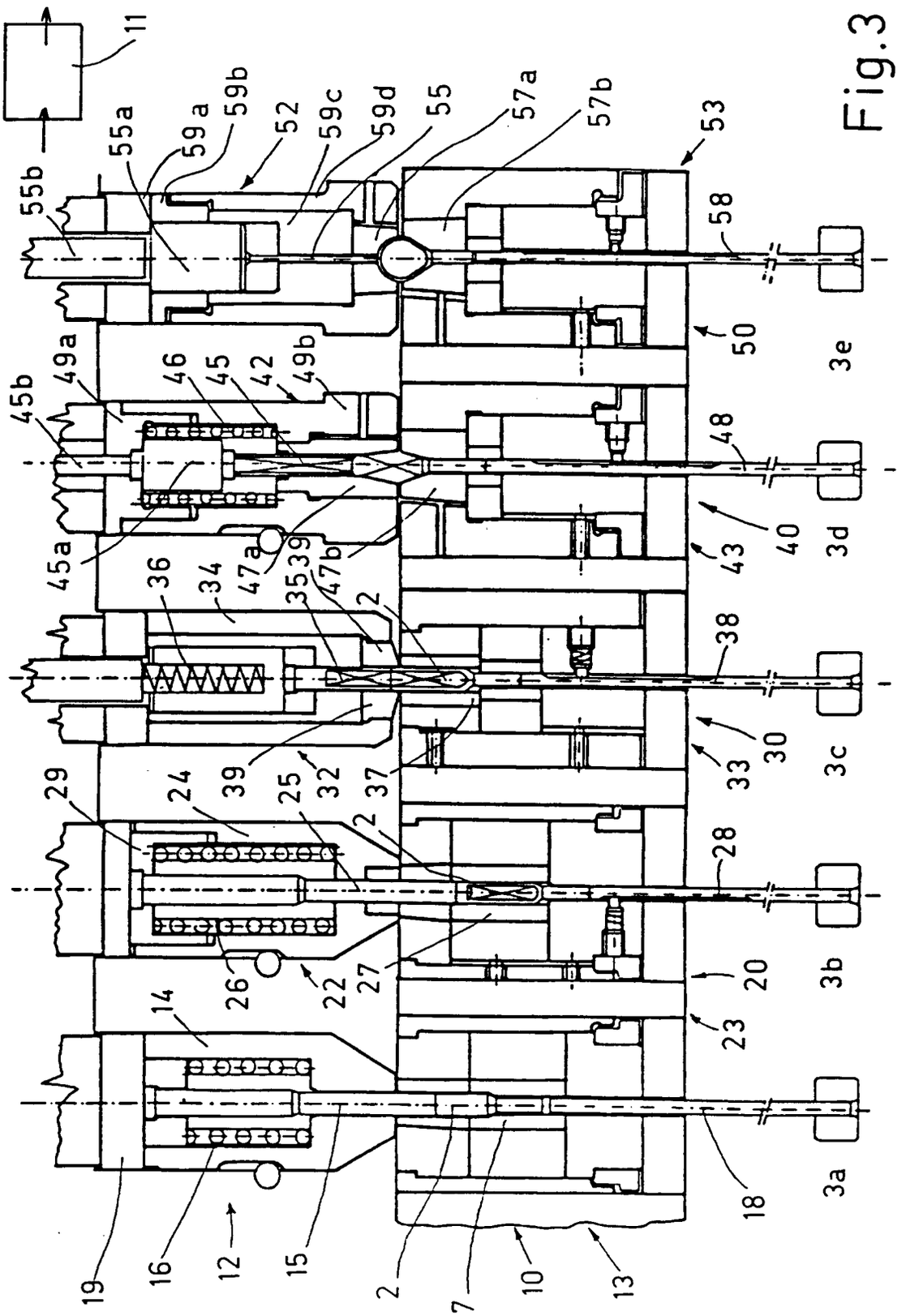
11
55b
55a
59a
59b
52
59c
59d
55
57a
57b
53
58
50
3e
49a
45b
46
45
42
49b
48
40
3d
45a
36
34
47a
35
39
47b
2
43
38
30
3c
33
29
24
39
25
32
37
2
28
3b
26
22
27
20
14
23
18
3a
19
16
12
15
2
17
10
13

Fig.3