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71 Applicant: **A/S RAUFOSS AMMUNISJONSFABRIKKER**
P.O. Box 2
N-2831 Raufoss(NO)

72 Inventor: **Slutas, Johan**
Nordre Husebyton 5D
N-7000 Trondheim(NO)

74 Representative: **Haggart, John Pawson et al,**
Page, White & Farrer 5 Plough Place New Fetter Lane
London EC4A EC4(GB)

54 **Method of making hollow rods and shafts.**

57 Method of making light metal hollow rods and shafts which comprise a tubular section and substantial solid head on each end of said section. In order to avoid joining together of the tubular section and the heads, and in order to avoid the poor strengt properties of light metals resulting from moulding, the rods and shafts are made by pressing of a bolt blank in a first extrusion step, by use of a plunger (2) having a substantial planar end for forming of a first solid head (1'), pressing the blank in a second step, by use of a plunger (3) having a mandrel (3') on its end, for forming the tubular section (1''), and pressing the blank in a third step, by use of a plunger (2) having a substantial planar end, for forming of a second solid head (1''').

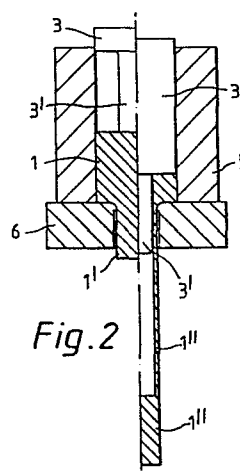


Fig. 2

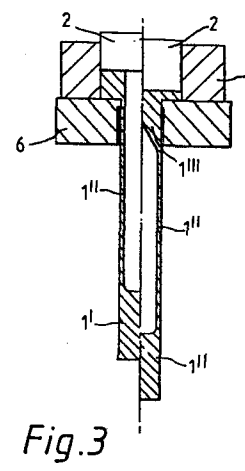


Fig. 3

Method of making hollow rods and shafts.

The present invention relates to a method of making hollow rods and shafts, i.e. elongate members having a tubular middle section and a head on each end. The heads on the finished product may have many different configurations, formed by for instance forging, drilling, milling. Such final shaping does not make a part of the present inventions, which concerns the making of hollow rods and shafts having solid heads. It lies within the scope of the invention that the thus formed products may be used without further treatment, but usually the products made by use of the method according to the present invention will be blanks adapted to be further treated into finished products.

It is well known that tubular shape is advantageous with respect to the ratio between strength (bending and torsional strength) and the material consumption. Consequently, a tubular shape is also advantageous with respect to the ratio between strength and weight.

As examples of fields of use for such rods and shafts are mentioned aircrafts and land vehicles. For both of these applications are preferred to use rods and shafts of high strength and low weight. For aircrafts a low weight means increased load capacity and low fuel consumption, and so is also the case for automobiles. Moreover, it is in most applications desirable to keep the production costs as low as possible.

The present invention is in particular concerned with the making of rods and shafts of light metals and light alloys, and in particular of aluminium and aluminium alloys.

Without making any limitation of the scope of the invention the following automobile parts can be made by use of the method according to the present invention:

Arms for lateral stabilization of rear axles

Wheel suspension arms

Steering rods

Pitman arms

Steering columns

5 Drive shafts

Rods for stabilization of the engine or for guiding the engine under the passenger compartment in case of a crash, and several other stabilizing and supporting rods and arms.

A known method of making hollow rods and shafts of the kind
10 in question is to connect the heads and the tube, for instance by welding, use of screws or transverse pins or by inserting parts of the heads in the tube ends and deforming the tube into recesses in the heads.

All types of joints increase the production costs, and
15 moreover, it may be doubtful whether the joints have the necessary strength, in particular after a long time of use. Failures in joints may of course have very serious consequences in some applications.

It is possible to make hollow rods and shafts by moulding,
20 but it is well known that moulding only gives the strength properties which are desired in some applications if large dimensions are used for the product.

The main object of the present invention is to achieve a method which makes it possible to make hollow rods and
25 shafts of high strengt from a one piece blank.

In accordance with the invention this it achieved by means of a method which comprises
pressing of a bolt blank in a first extrusion step, by use of a plunger having a substantially planar end, for forming
30 a solid head,
pressing the blank in a second step, by use of a plunger having a mandrel on its end, for forming of a tubular section, and
pressing the blank in a third step, by use of a plunger

having a substantial planar end, for forming a second solid head.

The method can be carried out merely by exchanging the plungers between the various steps. The blank is extruded 5 through the same nozzle in all the steps, and needs not be removed from the extrusion apparatus between the steps.

The method of the present invention will hereinafter be further explained, with reference to the accompanying drawing, which shows four different operations. All 10 the Figs. show longitudinal sections through an extrusion nozzle, through which a blank is pressed means of different plungers. The left half of each Fig. shows the blank and the plunger prior to the pressing, and the right half of each Fig. shows the blank and the plunger after the 15 pressing.

Thus, Fig. 1 shows to the left one half of a cylindrical blank 1, one half of a cylindrical plunger 2 and one half of a container 5. To the right in Fig. 1 is shown the situation after the first pressing step. The plunger has 20 pressed a solid part 1' of the blank 1 through the nozzle 6, said part of the blank having a reduced diameter relatively to the initial blank.

Fig. 2 shows to the left the same blank 1 as shown to the right in Fig. 1, but another plunger 3 having a mandrel 25 3' on its end has been mounted in the pressing apparatus. This results in the blank shown to the right in Fig. 2 after the second pressing step. The mandrel 3' has formed a tubular section 1'' following the solid head formed in the first step.

30 Fig. 3 shows to the left the same blank as shown to the right in Fig. 2, but the plunger having a mandrel has been

replaced by a plunger 2 having a planar end surface, i.e. the same plunger as shown in Fig. 1. Thus, the third pressing step results in the forming of a mainly solid head 1''', as shown below the plunger 2 to the right in Fig. 3. The use of the planar plunger 2 in the third step results in a flow of blank material inwardly towards the longitudinal center line of the blank, and it is possible to achieve a substantially solid head 1''' in this manner.

Fig. 4 shows to the left the blank in the shape as finished in the third step, as shown to the right in Fig. 3, and to the right in Fig. 4 is shown the at least temporarily finished product. In this fourth step is carried out a cutting of the rod, by use of a plunger 4 having a mandrel 4' which fits closely in the nozzle aperture, and the flange 1'''' formed on the second head 1''' of the rod in the third step is separated from the head, simultaneously with moving the rod out of the nozzle. It is to be noted, however, that this fourth step is not necessary in all cases, because the rod can be further pressed in the third step, until the flange on the second head becomes very thin, thus enabling the rod to be moved out of the nozzle by deforming the flange, whereupon the deformed flange can be removed by use of any suitable means.

The hollow space in the rod formed in the second step becomes a shape which is complementary to that of the mandrel 3'. The other end of said hollow space is, however, formed by a flow of material mainly radially, in the third step, and said other end of the hollow space will mainly be defined by a substantially conical surface, as shown in Figs. 3 and 4.

The wall thickness in the tubular section of the rod may of course be freely chosen, and is defined by the diameters

of the nozzle aperture and the mandrel 3' used in the third step, respectively.

As mentioned introductorily one or both heads may be machined or formed after the pressing, and also the tubular
5 section of the rod may be machined, for instance in a lathe in order to achieve an outside diameter which lies within desired tolerances.

The method according to the present invention makes it possible to make hollow rods from one piece of material,
10 and to achieve excellent strength properties. Moreover, joining of heads and the tubular section is avoided, and so is the doubt as to the quality of such joints.

Claims

1. Method of making light metal hollow rods and shafts which comprise a tubular section and a substantially solid head on each end of said section,
5 c h a r a c t e r i z e d in
pressing of a bolt blank in a first extrusion step, by use of a plunger (2) having a substantial planar end, for forming of a first solid head (1'),
pressing the blank in a second step, by use of a plunger
10 (3) having a mandrel (3') on its end, for forming the tubular section (1''), and pressing the blank in a third step, by use of a plunger (2) having a substantial planar end, for forming of a second solid head (1''').
2. Method as claimed in claim 1,
15 c h a r a c t e r i z e d in that all the steps are carried out in the same pressing apparatus, by exchange of the plungers (2,3) between the steps.
3. Method as claimed in claim 1 or 2,
c h a r a c t e r i z e d in that the plunger used in
20 the third step has a mandrel of less diameter than the mandrel used in the second step, for forming of an aperture through the second head.
4. Method as claimed in one of claims 1 to 3,
c h a r a c t e r i z e d in that the rod or shaft
25 after the third step is separated from the rest of the blank by pressing by means of a plunger (4) having a mandrel (4') of a diameter corresponding to that of the aperture through the nozzle (6) of the pressing apparatus.

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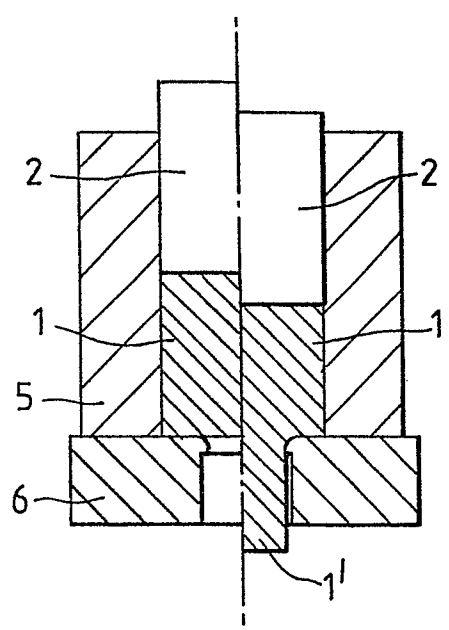


Fig. 1

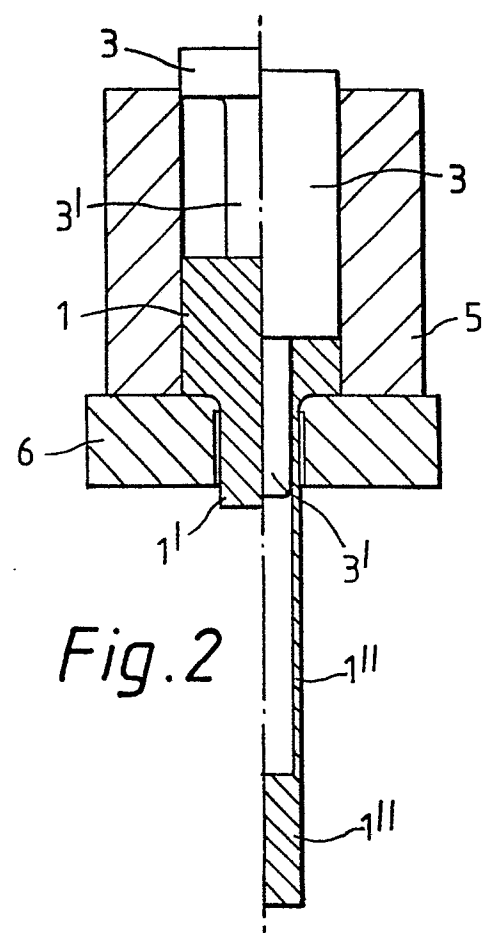


Fig. 2

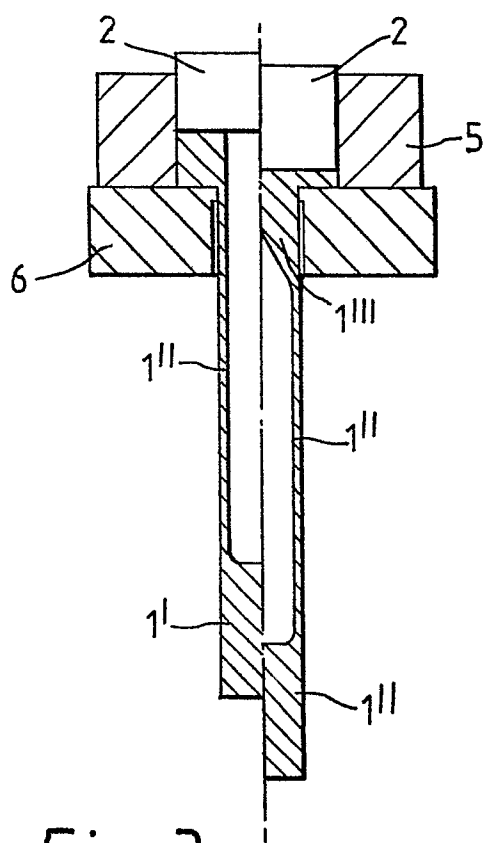


Fig. 3

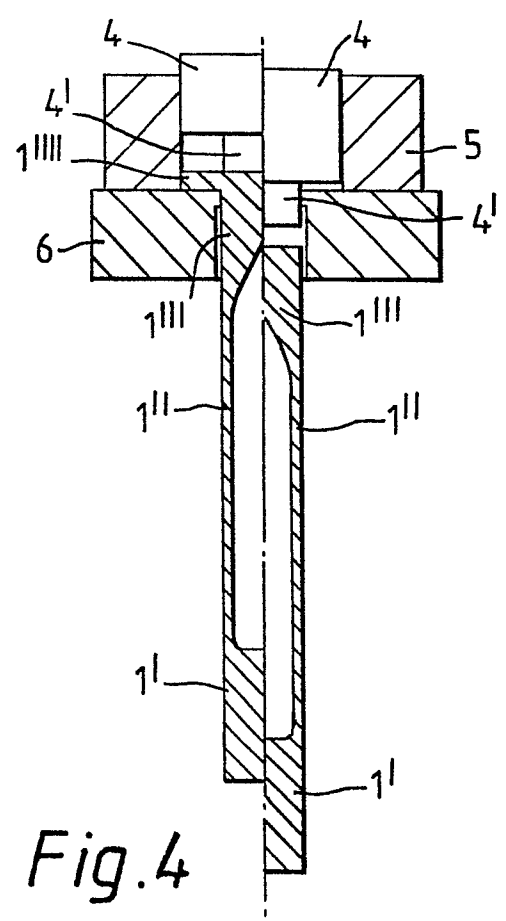


Fig. 4



European Patent
Office

EUROPEAN SEARCH REPORT

0102427

Application number

EP 82 30 4647

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. *)
X	GB-A- 923 725 (LEMELSON) * Claim 1 ; figure 1 ; page 2, lines 98-128 *	1,2	B 21 C 23/14 B 21 C 25/08
X	DE-C- 129 857 (FRANK) * Claim 1 ; figures 1-5 *	1,2	
A	US-A-4 292 831 (SIMON) * Figures 1-5 *	3	
A	CH-A- 308 330 (KREIDLER)		
			TECHNICAL FIELDS SEARCHED (Int. Cl. *)
			B 21 C 23/00 B 21 C 25/00
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 09-03-1983	Examiner SCHLAITZ J
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	