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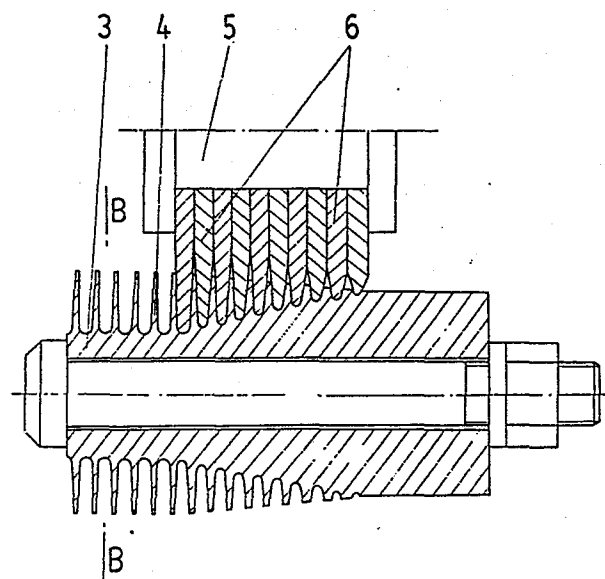
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⑤④ **A method of drawing ribs on tubes.**

⑤⑦ A method of drawing ribs on tubes in characterized by that into the material of the tube from which the rib is drawn initial compressive stresses are introduced of the quantity preferably

$$(0.2-0.7) \frac{F_o - F_r}{F_o} \cdot Re,$$

where F_o denotes the area of the cross-section of the tube before drawing, F_r denotes the area of the cross-section of the core of the tube after drawing the rib, and Re is the plasticity limit. Next, ribs are drawn by driven tools with rolling-form-disks by the known method.



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A method of drawing ribs on tubes

The subject of the invention is a method of drawing ribs on tubes, especially ribs of small pitches or ribs on tubes of low-plastic materials.

- 5 Hitherto, production of ribs on tubes by the drawing method, called also the rolling method, has been carried out in heads comprising usually three symmetrically arranged cylinders composed of a series of rolling disks. The axis of each cylinder forms with the axis of rolling,
- 10 which is the axis of the tube, a constant angle. The value of the said angle results from the geometrical dependencies of the helical outline of ribs drawn on the tube. Cylinders are driven with rotary motion, due to what, after introducing the tube into the zone of the
- 15 action thereof, the cylinders transmitting the rotary motion to the tube draw the rib. Forming the ribs on the tube is the result of producing in the zone of the action of the tool a corresponding state of stresses in the material of the tube, causing a plastic strain. The
- 20 material of the tube deforms in the zone of the action of the tool in the axial and radial direction. Radial strain manifests itself in a form of increasing the diameter of ribs, and axial strain manifests itself in a form of elongation of the tube. Elongation of the tube

in the process of drawing the ribs is a disadvantageous phenomenon because the quantity of the elongation is random variable for each segment of the tube. This characteristic causes the necessity of applying technological allowances, and thus, production of wastes. Axial strains of the tube are caused by corresponding axial stresses induced by the tool in the zone of its operation. In the result of the action of the said stresses the tool is subject to very high loads in the axial direction. The said loads cause bending out the disks of which the tool consists. In the result thereof the pitch of ribs is not uniform and always bigger from the pitch of the disks. The substantial problem in the hitherto applied methods of drawing the ribs is a low durability of the tool whose disks are destroyed in the result of the action of bending loads of a fatigue character.

The Polish patent specification no. 113419 presents the design of a tool with the use of an additional disk stiffening the tool and increasing its durability. Such a solution does not eliminate, however, the elongation of the tube and it is difficult to draw ribs of very small pitches on tubes of materials having big resistance of the plastic strain because the increase of loads in the axial direction of the tool is considerably bigger than the possibility of increasing the rigidity of the tool.

The US patent specification no. 3,876,593 presents a method of procuding bimetallic ribbed tubes with the application of blocking the possibility of elongation of the tube on which ribs are drawn. This blocking consists in clamping the end of the external tube on the internal tube, and then the drawing process starts from the second,

free end of the tube. During drawing ribs by the said method different values of axial stresses are observed along the length of the tube. In the initial stage, when starting drawing the ribs from the free end of the tube, 5 axial stresses in the non-deformed part of the tube grow systematically till reaching a definite state of equilibrium of stresses in the material of the external tube. At the same time, in the result of increasing axial stresses, in the external tube, from the value "0" at the 10 beginning to the value corresponding to the state of equilibrium, the diameter of ribs increases from a certain initial quantity to the required quantity. The segment of the tube with different diameters of ribs usually does not meet the requirements imposed to dimensional tolerances and is a waste material. A disadvantageous phenomenon in the first stage of drawing is also 15 the excessive bending load of the disks of the tool.

The essence of the method of drawing ribs on tubes 20 according to the invention consists in that to the material of the tube from which ribs are drawn initial compressive stress is introduced, of the quantity smaller from the plasticity limit R_e of the material of the tube, and then in the zone of the action of disk tools, with 25 maintenance of the initial compressive stress in the material of the tube, ribs are formed by pressing down to the tube driven rolling-disk tools. It is preferable when the quantity of the initial compressive strength is

30 $(0.2 - 0.7) \frac{F_o - F_r}{F_o} \cdot R_e$, where F_o denotes the

size of the area of the section of the tube, and F_r denotes the size of the area of the section of the core

of the tube, after drawing the rib. By introducing the initial state of compressive stresses to the material of deformed tube, the tool is discharged from loads along the axis, bending out the rolling-form-disks, practically
5 already in the first stage of the contact of the tool with the material. Another effect of introducing the initial state of compressive stresses is the avoidance of the axial elongation of the tube. In these conditions the work or the tool resolves itself to inducing plastic
10 strains of the tube in the radial direction.

By realizing the production of ribbed tubes with the presented method tubes of a constant geometry over the whole length are obtained, with maintenance of the high
15 service life of tools. By means of the tool discharged from harmful bending stresses it is possible to draw ribs of very small pitches and big heights, from materials having high plasticity limits.

20 The method of drawing ribs on tubes according to the invention is presented in more detail in the drawings, wherein shows:

Fig. 1 the tube clamped with a screw and the diagram of
25 compressive stresses of the said tube,

Fig. 2 the axial section through the tube and the tool in the course of drawing ribs,

30 Fig. 3 the cross-section through the tube before the operation of drawing ribs, and

Fig. 4 the cross-section through the tube after drawing ribs.

The tube 1 before the operation of drawing ribs has been clamped with a screw 2, thus inducing the origination of an initial compressive stress of an established quantity. The quantity of the said stress is preferably

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$(0.2 - 0.7) \frac{F_o - F_r}{F_o} \cdot Re$, where F_o is the size

of the area of the cross-section of the tube before the drawing operation, F_r is the size of the area of the
10 cross-section of the core of the tube 3 after the operation of drawing the rib 4, and Re is the plasticity limit of the material of the tube. After initial clamping the tube 1 with the screw 2, the tube is introduced into the zone of the action of driven tools 5 provided with
15 rolling-form-disks 6. During drawing of ribs 4 axial stresses practically do not act on the disks 6, what enables obtaining very small pitches of ribs, and the material of the tube is subject to plastic strains only in the radial direction.

PATENT CLAIMS

1. A method of drawing ribs on tubes by means of tools driven with rotary motion and comprising rolling-form-disks, characterized in that into the material of the tube (3) from which ribs (4) are drawn an
5 initial compressive stress is introduced with a quantity being smaller than the plasticity limit Re of the material of the tube, and that then in the zone of the action of disk tools (6) maintaining of the initial compressive stress in the material of the tube,
10 ribs are formed by pressing down the driven rolling-form-disk tools to the tube.
2. A method of drawing ribs on tubes according to claim 1, characterized in that the quantity of the initial
15 compressive stress is
- (0.2 - 0.7) $\frac{F_o - F_r}{F_o}$. Re , where F_o denotes the size
20 of the area of the cross-section of the tube before drawing, and F_r denotes the size of the area of the cross-section of the core of the tube (3) after drawing the rib.

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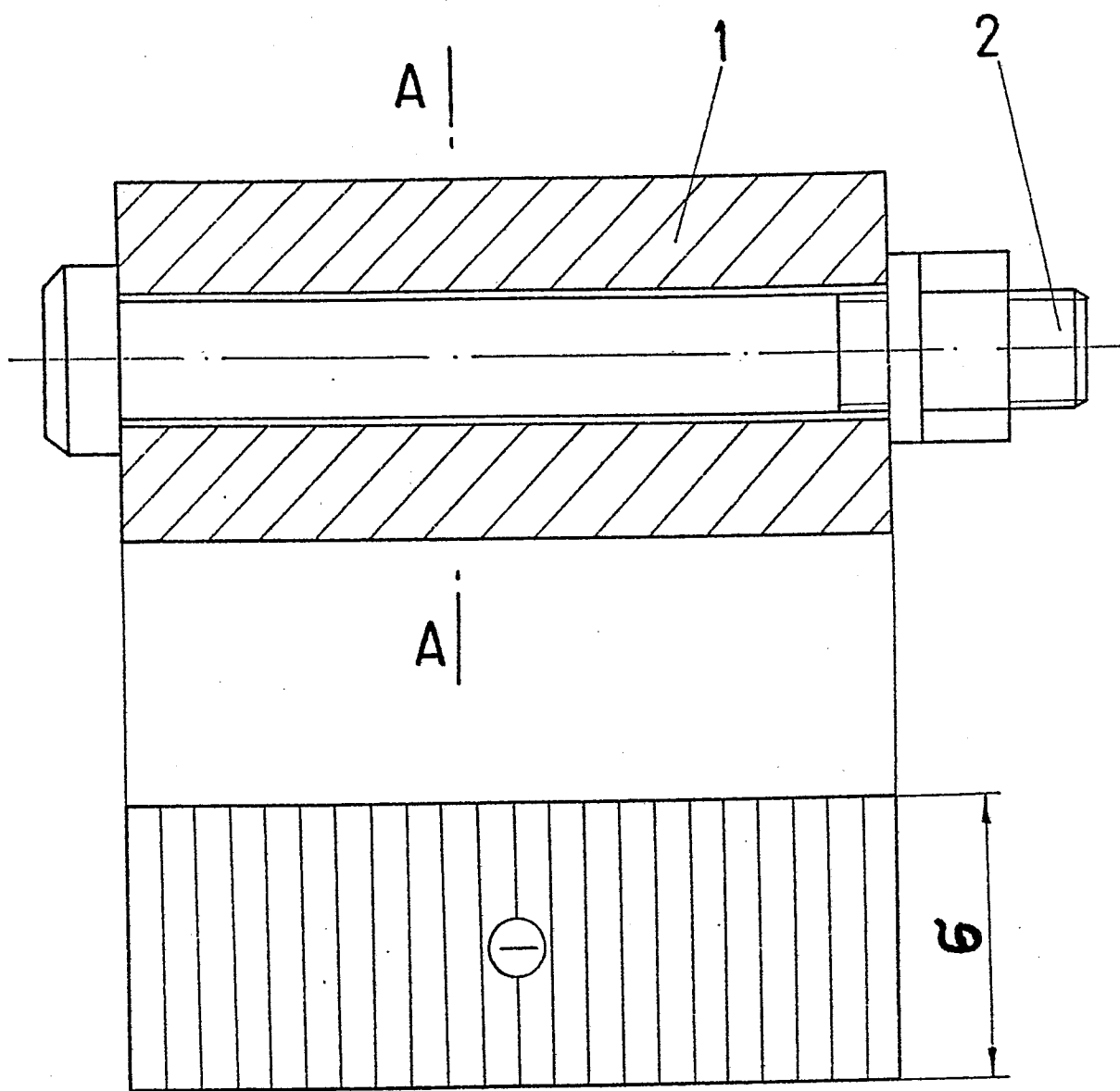


Fig. 1

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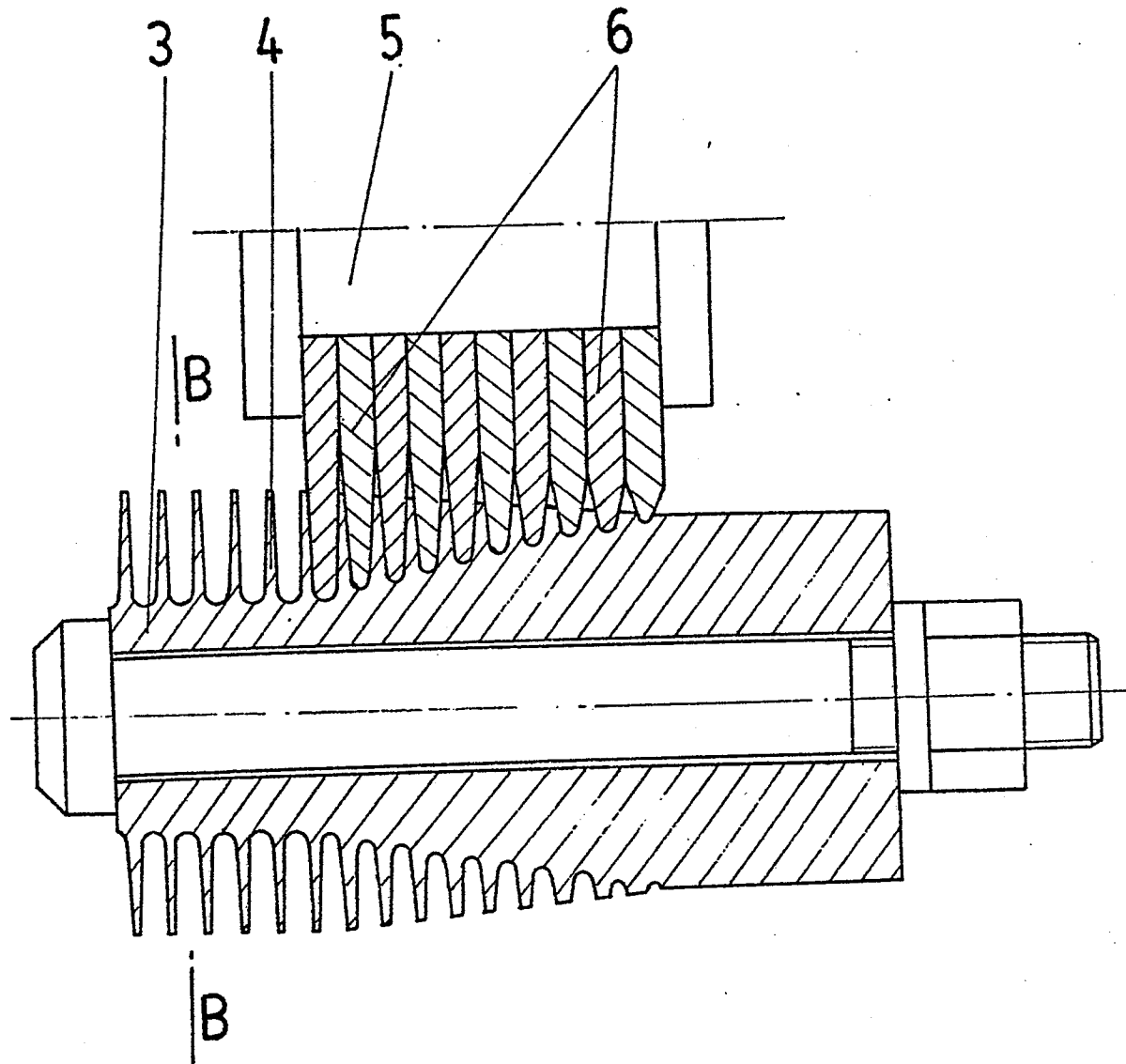


Fig. 2

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A - A

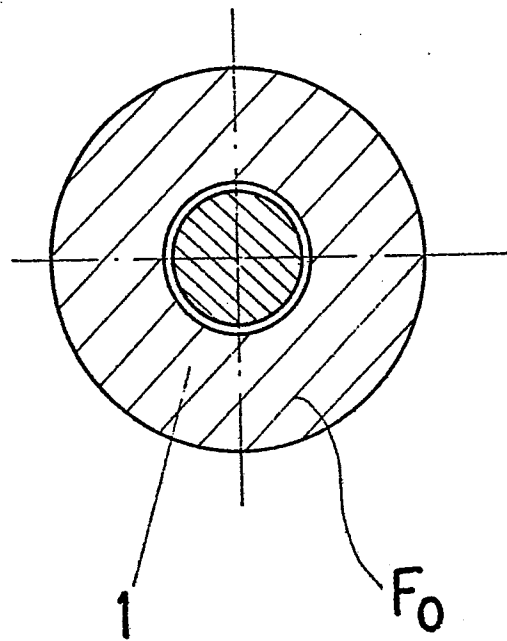


Fig. 3

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B - B

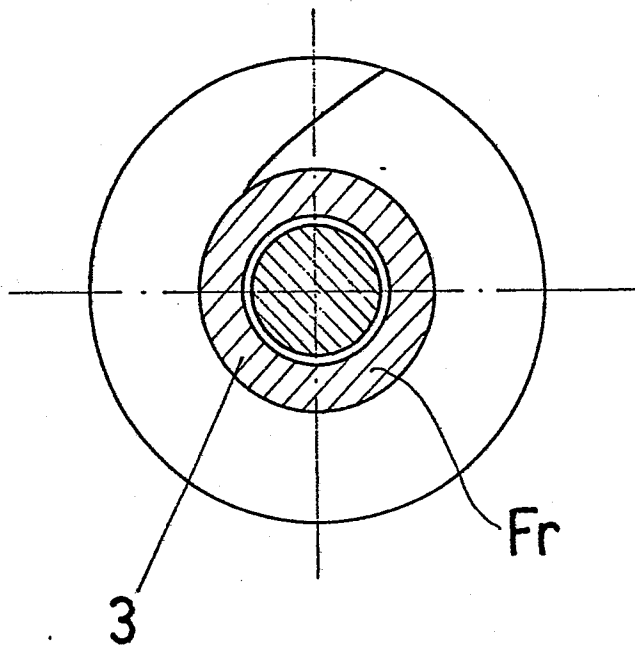


Fig. 4



DOCUMENTS CONSIDERED TO BE RELEVANT			EP 84103536.3
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
A	GB - A - 651 829 (CALUMET) * Claims 1-4; fig. 3,4 *	1	B 21 D 53/06
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A	US - A - 2 463 997 (J.S. RODGERS) * Totality *	1	
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A	US - A - 3 881 342 (JOHN K. THORNE) * Totality *	1	
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A	US - A - 4 353 234 (WARREN S.) * Claims 1-3; fig. 2,4 *	1	
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A	US - A - 3 868 754 (MATSUO KAWANO) * Totality *	1	

The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			B 21 D 51/00 B 21 D 53/00
Place of search VIENNA		Date of completion of the search 13-07-1984	Examiner DRNOWITZ
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			