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(54) **ROLL-HARDENING DEVICE IN A ROLL-HARDENING MACHINE FOR CRANKSHAFTS**

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(57) **ABSTRACT**

The deep-rolling device (**8**) of a deep-rolling machine (**1**) for crankshafts (**3**) is made in scissor construction. Two swivellable scissor arms (**9, 10**) opposite each other each carry a deep-rolling roller head (**13**) or a backing roller head (**14**) respectively. The backing roller head (**14**) is fitted with two parallel-axis backing rollers, the rotational axes of which lie in a common plane. The backing roller head (**14**) also has an axial guide which is arranged in front of the backing rollers in swivel direction (**35**) for closing, the longitudinal axis of which guide stands perpendicular to the rotational axis of the crankshaft (**3**) and lies in a plane which forms an acute angle with the common plane of the rotational axes of the backing rollers, and the axial width of which is greater than the width of the backing roller head (**14**) and slightly smaller than the distance of adjacent oil collars of a main bearing journal or big end bearing journal.

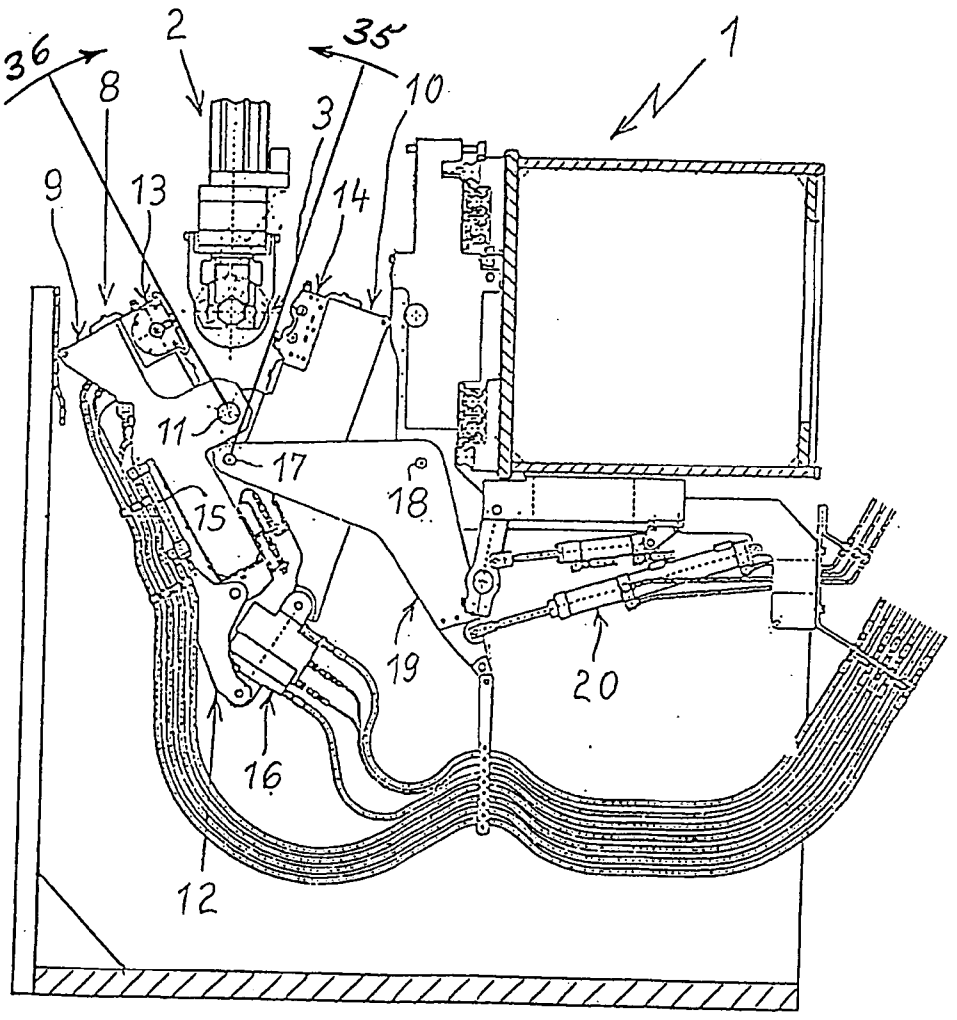

Fig. 1

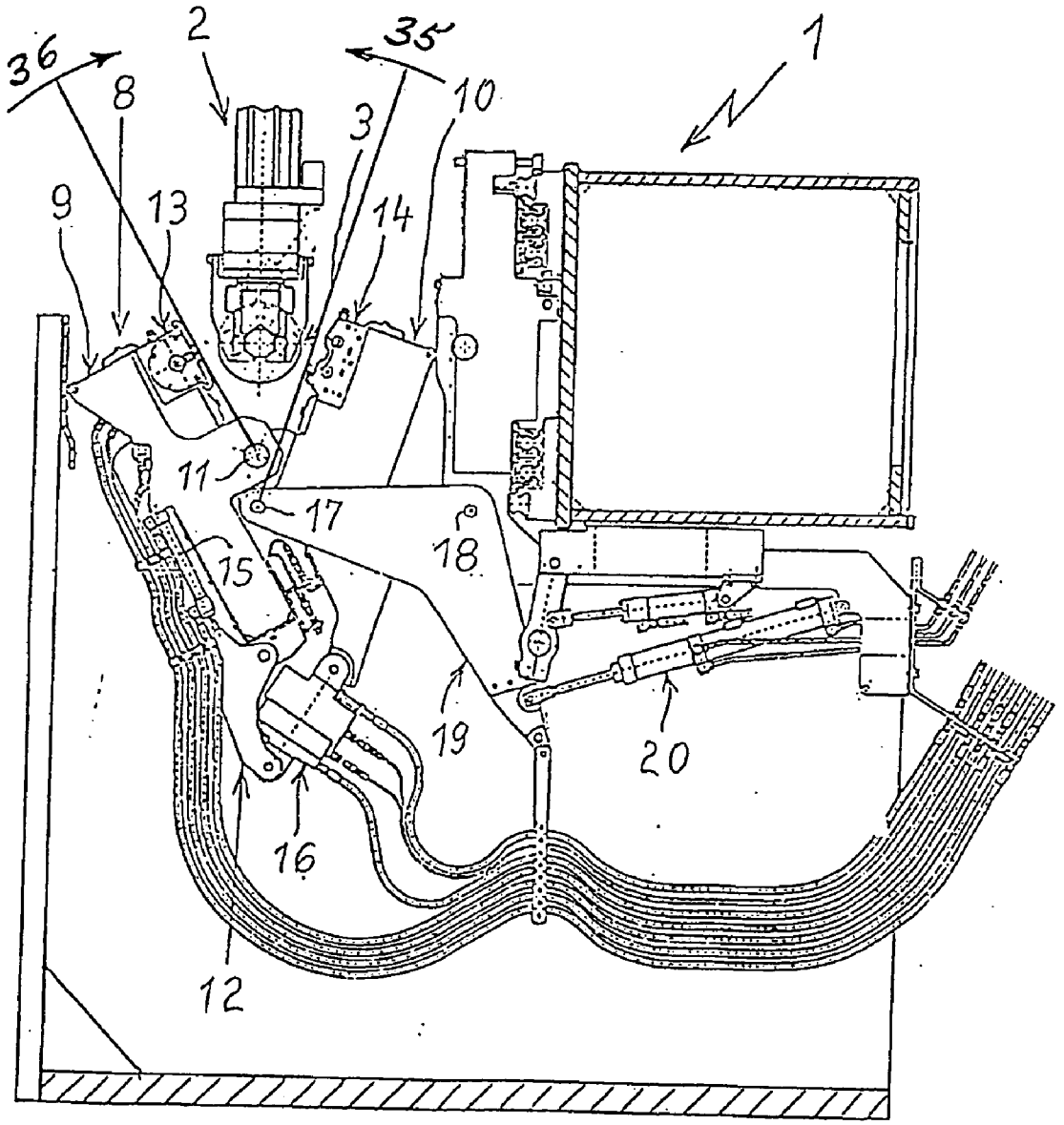

Fig. 2

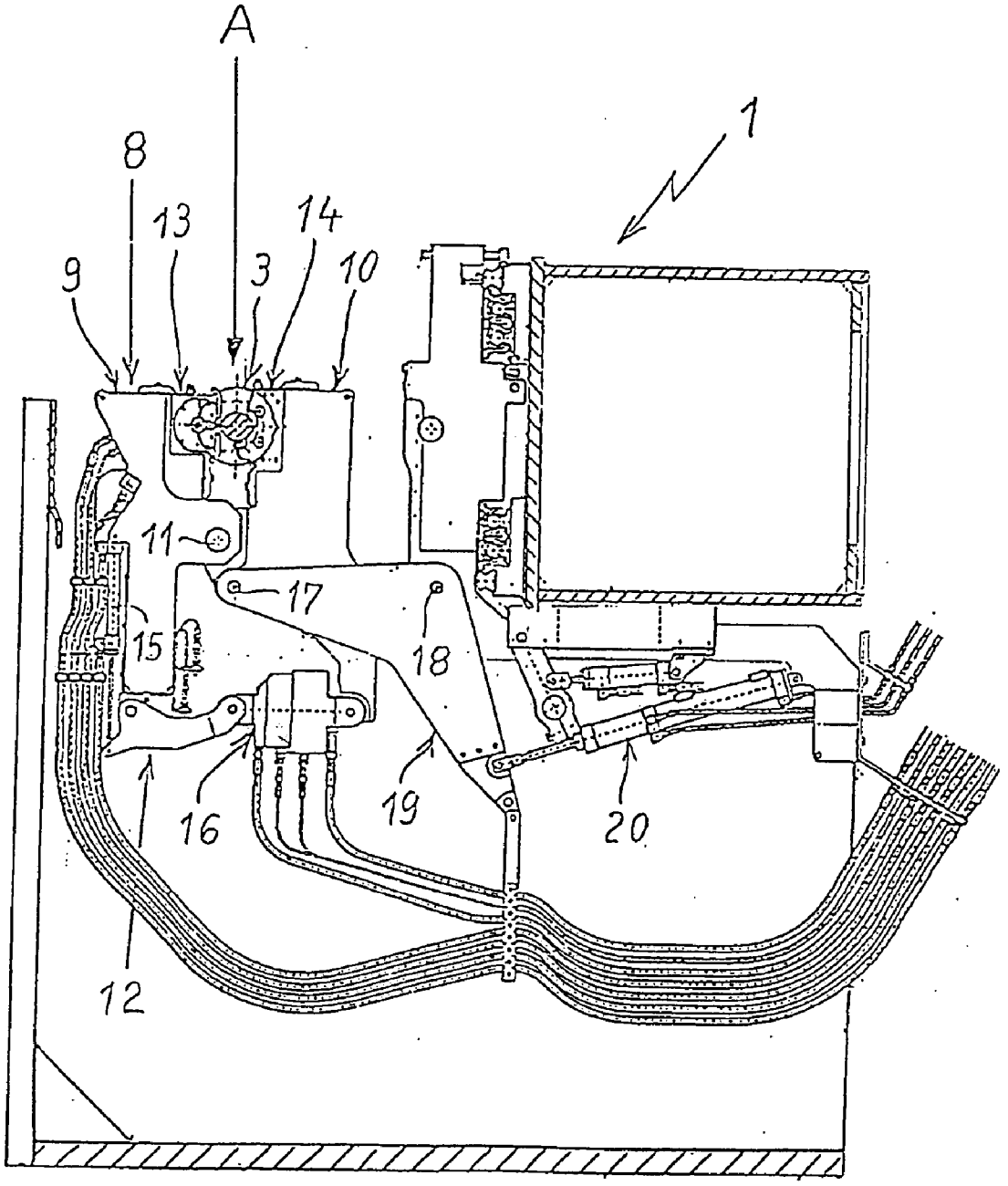

Fig. 4

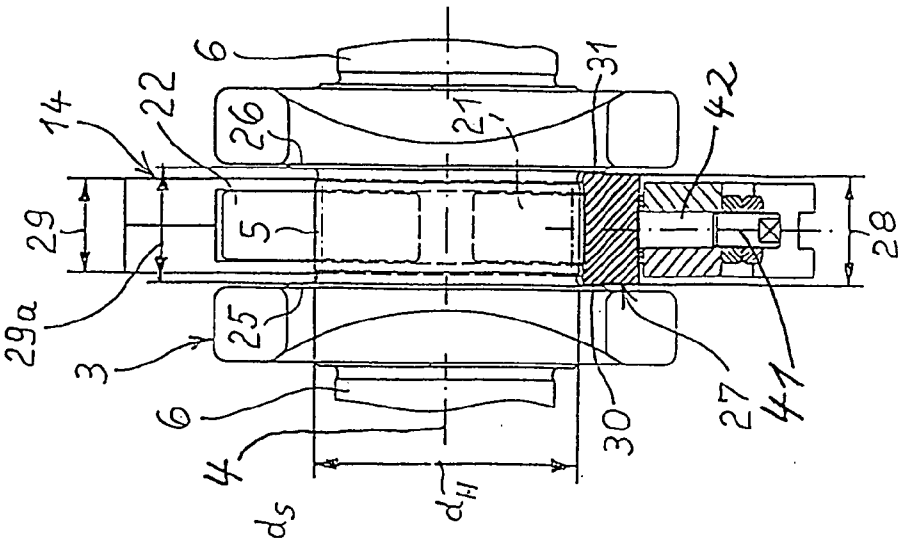
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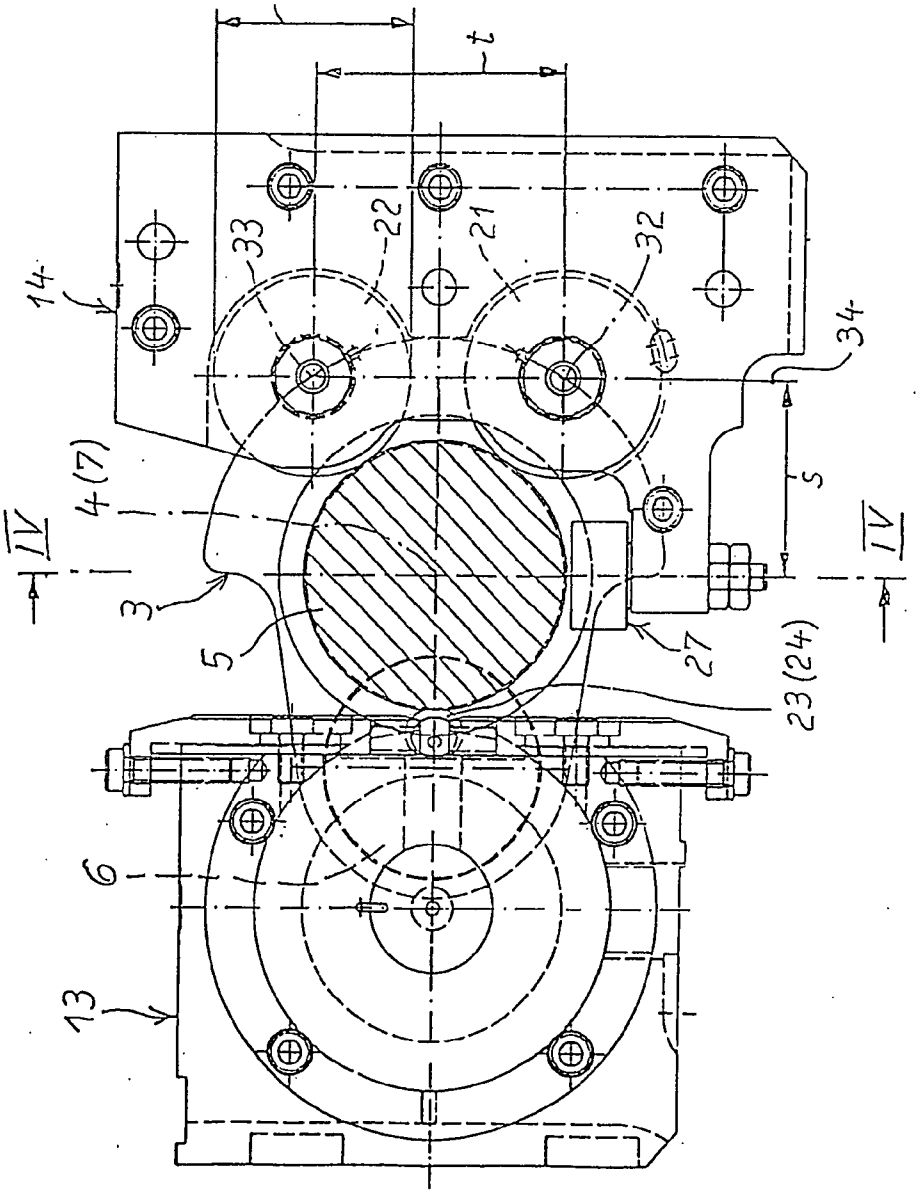
Fig. 3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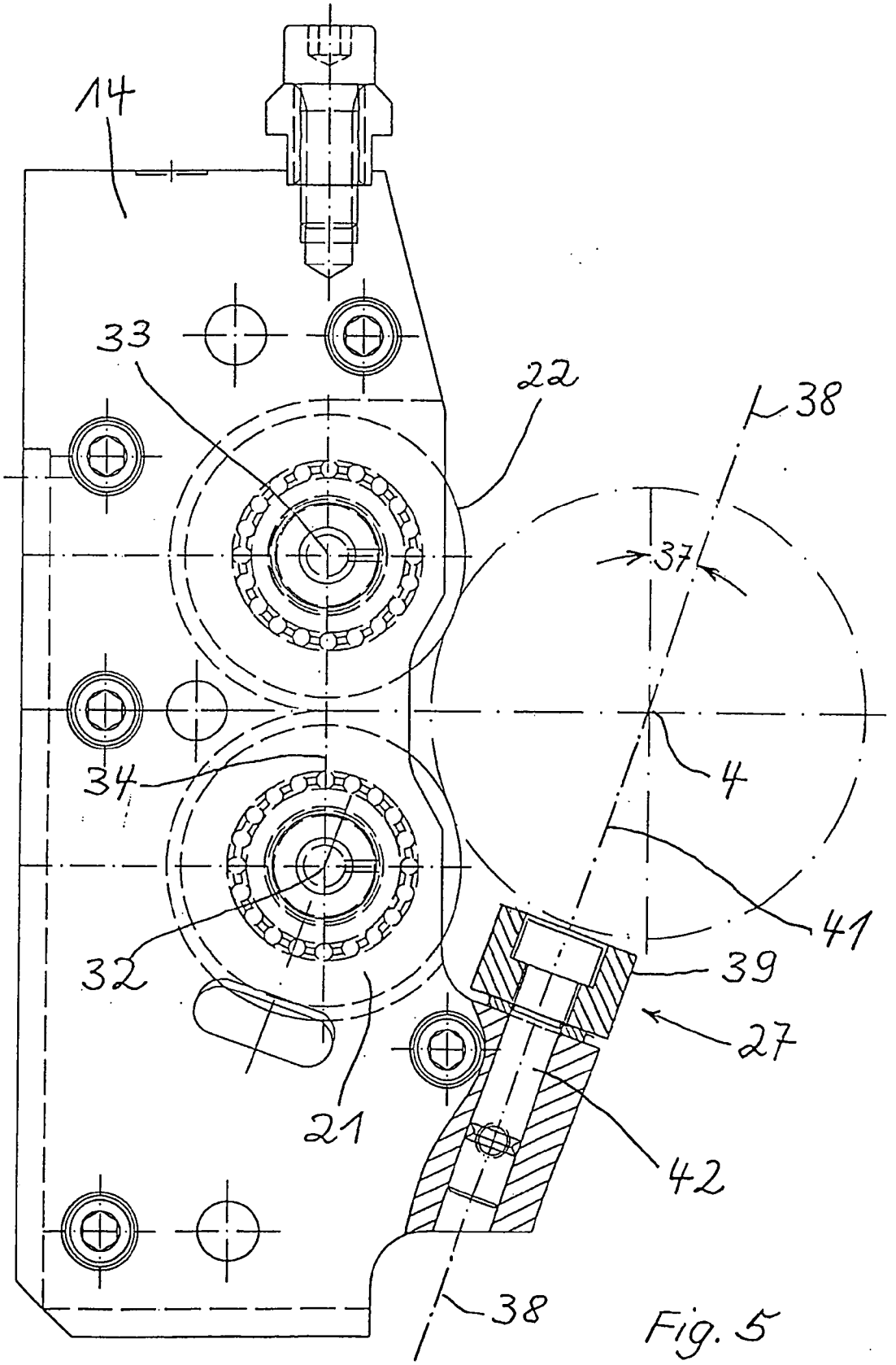

Fig. 5

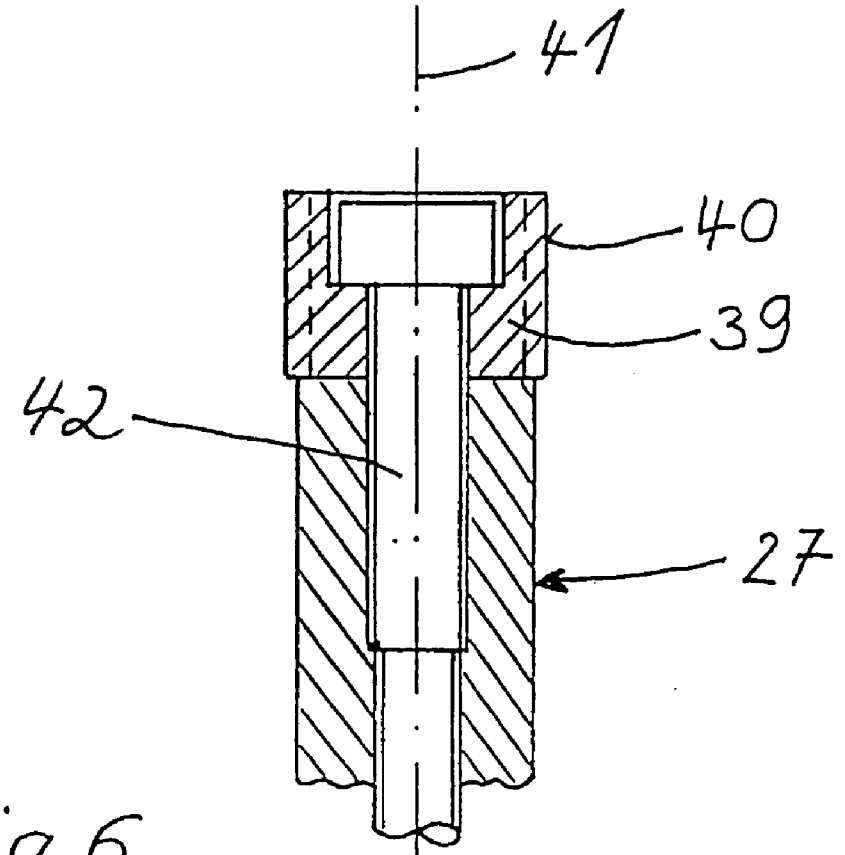

Fig. 6

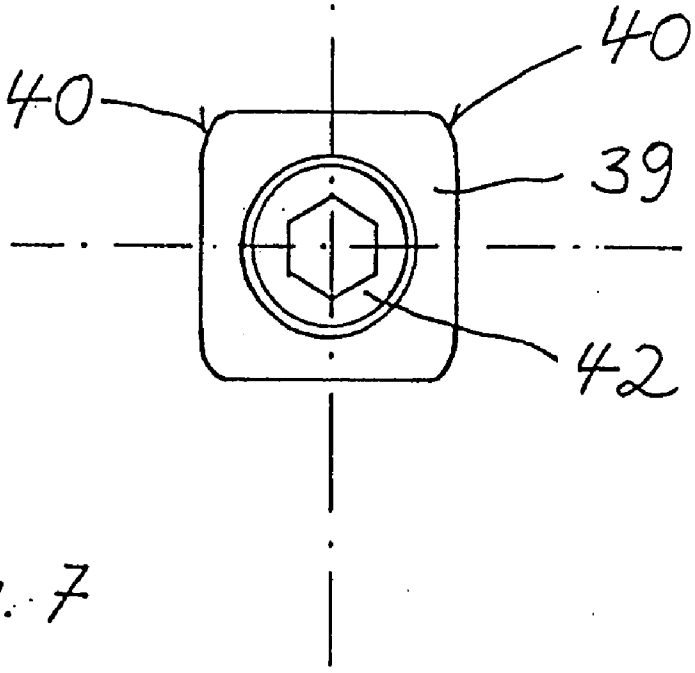

Fig. 7

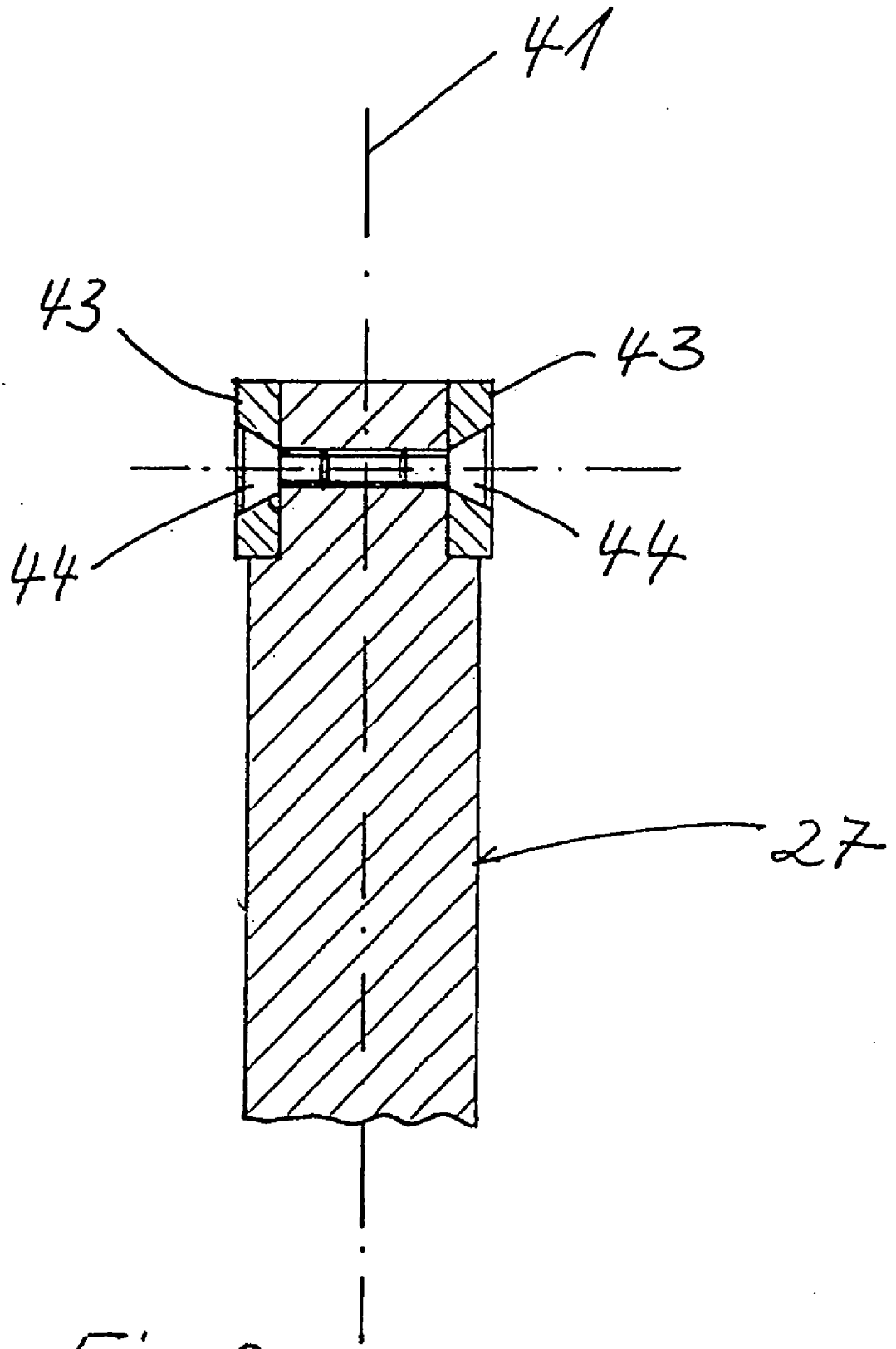

Fig. 8

ROLL-HARDENING DEVICE IN A ROLL-HARDENING MACHINE FOR CRANKSHAFTS

[0001] The invention relates to a deep-rolling device of a deep-rolling machine for crankshafts which is designed in scissor construction and in which two swivellable scissor arms lying opposite each other each carry a deep-rolling roller head or a backing roller head respectively, the backing roller head being fitted with two parallel-axisly arranged backing rollers of which the rotational axes lie in a common plane, with a drive device which generates the closing and opening movement of the deep-rolling device and the deep-rolling force.

[0002] Deep-rolling devices of the said type are known from German patent specification DE 197 22 308 C1, the object of which is a deep-rolling machine for crankshafts.

[0003] In such a deep-rolling machine, a deep-rolling device is allocated to each main bearing journal and big end bearing journal of a crankshaft.

[0004] The design of the known deep-rolling machine is such that when closing each deep-rolling device, first the backing rollers of the backing roller head and then the deep-rolling rollers of the deep-rolling roller head are pressed on one of the main bearing or big end bearing journals of a crankshaft.

[0005] The backing roller head and the deep-rolling roller head perform a feed motion and each a swivel motion.

[0006] The swivel motion of the backing roller head and deep-rolling roller head in the closing direction carries a risk that a collision can occur between the backing roller head or deep-rolling roller head and the crankshaft in the area of an oil collar as the clearances between the backing roller head and the deep-rolling roller head on the one hand and the two oil collars of a main bearing and big end bearing journal on the other hand are very narrow.

[0007] The underlying object of the invention is to structure a deep-rolling device of the type cited initially so that the swivel motion of the backing roller head and deep-rolling roller head in the closing direction cannot trigger a collision with the crankshaft in the area of an oil collar.

[0008] According to the invention this object is achieved in that the backing roller head has at least one axial guide which rollers in swivel direction is arranged in front of the backing to close the scissor arm carrying the backing rollers, the longitudinal axis of which guide is perpendicular to the rotational axis of the crankshaft and lies in a direction which encloses an acute angle with the plane of the rotational axes of the backing rollers, and the axial width of which guide is greater than the width of the backing roller head and slightly less than the distance of the oil collars of a main bearing journal or big end bearing journal.

[0009] As a result of the invention, on closing the deep-rolling device, before the backing rollers impact against an oil collar, the deep-rolling device is aligned in the axial direction of the crankshaft.

[0010] Such an alignment of the deep-rolling device ensures that the swivel movement of the deep-rolling roller head in the closing direction cannot lead to a collision of the deep-rolling roller head with the crankshaft in the area of an oil collar.

[0011] In the case where the acute angle between the longitudinal axis of the axial guide and the common plane formed by the rotational axes of the two backing rollers amounts to 0°, the axial guide has a distance from the common plane. The outer contour of the axial guide can have other forms than well as the classically prismatic or cylindrical form and e.g. be crowned or composed from several geometric shapes.

[0012] To machine particularly wide shaft bearing journals, instead of a single guide several axial guides can be provided which are arranged next to each other and fill the gap between two adjacent oil collars. Usually two axial guides are provided, the outer width of which is such that the two axial guides fit in the space between the oil collars with a slight lateral play. Such an arrangement also has the advantage that the axial guides are relatively small. At the same time this reduces the lateral friction between the axial guides and the oil collars.

[0013] The invention is now described in more detail below with reference to diagrammatic drawings showing embodiment examples.

[0014] **FIG. 1** shows a section through a deep-rolling machine with a part view of a crankshaft transport device, where a deep-rolling device assumes its opening position opposite an introduced crankshaft,

[0015] **FIG. 2** shows the cross section through the deep-rolling machine and a section through a main bearing journal of the crankshaft where the deep-rolling machine is in its closed position,

[0016] **FIG. 3** shows a section A of **FIG. 2** in enlarged scale,

[0017] **FIG. 4** shows a section along line IV-IV in **FIG. 3**,

[0018] **FIG. 5** shows a section analog to **FIG. 3** with a special arrangement of the axial guide,

[0019] **FIG. 6** shows a first embodiment of an axial guide in longitudinal section,

[0020] **FIG. 7** shows a top view onto the embodiment according to **FIG. 6**,

[0021] **FIG. 8** shows a second embodiment of the axial guide in longitudinal section.

[0022] A deep-rolling machine **1** is fitted with a drive device (not shown) which serves to hold a crankshaft **3** introduced in the deep-rolling machine **1** with a crankshaft transport device **2**.

[0023] The drive device generates the rotational movement of the crankshaft **3** about its axis **4** during the deep-rolling of the main bearing journal **5** and big end bearing journal **6**. The axis **4** thus lies in the axis of rotation **7** of the drive device.

[0024] The present embodiment example is restricted to the deep-rolling of a main bearing journal **5** of the crankshaft **3** as this suffices to explain the subject of the invention.

[0025] Allocated to the main bearing journal **5** is a deep-rolling device **8** in scissor construction which is fitted with two scissor arms **9**, **10**, a scissor rotation point **11**, a drive device **12**, a deep-rolling roller head **13** and a backing roller head **14**. Due to the scissor construction the deep-rolling

roller head **13** and the backing roller head **14** cannot be moved individually in the direction along the rotational axis **4**. Rather they are arranged and adjustable only in particular planes of the deep-rolling machine **1** corresponding to the respective position of the main bearing journal **5** or big end bearing journal **6** to be machined along the rotational axis **4** of the crankshaft **3**. Such a plane is shown for example in **FIG. 3** and **FIG. 4**.

[**0026**] The drive device **12** for the deep-rolling device **8** has an adjustment cylinder **15** and a force device **16**.

[**0027**] The adjustment cylinder **15** generates the closing and opening movement of the scissors **9, 10** described above of the deep-rolling device **8**; the force device **16** generates the deep-rolling force. Due to the division of the movements generated by cylinders **15** and **16**, a particularly narrow construction of the deep-rolling device **8** is achieved.

[**0028**] The deep-rolling device **8** is hinged about a hinge point **17** on an angle lever **19** swivellable about an axis **18**.

[**0029**] The angle lever **19** can be swivelled using a piston cylinder unit **20**. By actuating the piston cylinder unit **20**, the deep-rolling device **8** is brought into and out of the working position i.e. moved in the direction of and opposite to the direction of the axis **4** of the crankshaft **3**.

[**0030**] The deep-rolling machine **1** is designed so that on closing the deep-rolling device **8** first the two parallel-axisly arranged backing rollers **21** and **22** of the backing roller head **14** and then the two deep-rolling rollers **23** and **24** of the deep-rolling roller head **13** come to rest on the main bearing journal **5**.

[**0031**] Here in the view in **FIG. 1** the backing roller head **14** executes a swivel movement **35** counterclockwise and the deep-rolling roller head **13** a swivel movement **36** clockwise about the scissor rotation point **11**. The two swivel movements **35** and **36** are performed simultaneously under movement of point **17** in the direction of axis **4** and at their end the closed position is achieved as shown in **FIG. 2**. The closed position corresponds to the working position of the deep-rolling device **8**.

[**0032**] In the swivel movements **35** and **36** of the backing roller head **14** and deep-rolling roller head **13** in the closing direction, a collision with one of the two oil collars **25** or **26** of the main bearing journal **5** is avoided by an axial guide **27**. The axial guide **27** is arranged at an acute angle **37** between 0 and 45° to the plane **34** which contains the two rotational axes **32** and **33** of the two backing rollers **21** and **22**. The longitudinal axis **41** of the axial guide **27** stands vertical to the rotational axis **4** of the crankshaft **3** (**FIG. 5**).

[**0033**] The direction **38** of the longitudinal axis **41** of the axial guide **27**—geometrically viewed—encloses the rotational axis **4** of the crankshaft **3** i.e. the longitudinal axis **41** can swing about the rotational axis **4**. Comparison of **FIGS. 3 and 5** clearly shows this possibility. For example in the view in **FIG. 3** the direction **38** falls in the section plane IV-IV, i.e. the acute angle **37** is 0° and the axial guide **27** has a lateral distance s from the plane **34** containing the two rotational axes **32** and **33**. In this special case the plane **34** and the direction **38** run parallel with each other.

[**0034**] In **FIG. 5** in contrast the axial guide **27** in relation to the common plane **34** of the two rotational axes **32** and **33** of the backing rollers **21** and **22** lies at an acute angle **37** which is greater than 0°. This structure means that on swivelling of the backing roller head **14** into the closed position in the direction of the swivel movement **35**, the axial guide **27** precedes the two backing rollers **21** and **22**. Thus the axial guide **27** precedes the backing rollers **21** and **22** on entering the space defined by the distance **29***a* of the two oil collars **25** and **26** on the main bearing journal **5**. This prevents one of the backing rollers **21** or **22** hitting against one of the oil collars **25** or **26** when the deep-rolling device **8** is closed.

[**0035**] The axial guide **27** can take different forms. In **FIG. 3** for example it has a cylindrical form. In **FIG. 5** the axial guide **27** has a multiple contour composed of a prismatic body **39** with chamfered edges **40**. The axial guide **27** is attached to the backing roller head **14** by a socket screw **42**. In the case of bearing journals **5** which have a particularly large width **29***a*, instead of a single axial guide **27** two axial guides (not shown) can be arranged next to each other where the one lies at the oil collar **25** and the other at the oil collar **26**.

[**0036**] Instead of the prismatic body **39** the axial guide **27** can be fitted with lateral sliding bodies **43** which are screwed via countersunk bolts **44** to the body of the axial guide **27**. The sliding bodies **43** can for example comprise non-ferrous metal, Teflon, hardened or coated steel, which have particularly good sliding properties.

[**0037**] Because of the scissor construction of the deep-rolling device **8**, the axial guide **27** at the same time guides the deep-rolling roller head **13** in the axial direction of the crankshaft **3**.

[**0038**] The width **28** of the axial guide **27** is greater than the width **29** of the backing roller head **14** and slightly smaller than the distance **29***a* of the oil collars **25, 26** of the main bearing journal **5**.

[**0039**] In the closed position of the deep-rolling device **8** (**FIG. 2**), for the two spaces **30, 31** around 0.25 mm play on each side is provided between the oil collars **25, 26** and the axial guide **27**.

[**0040**] Reference List

[**0041**] **1** Deep-rolling machine

[**0042**] **2** Crankshaft transport device

[**0043**] **3** Crankshaft

[**0044**] **4** (Rotational) axis of the crankshaft

[**0045**] **5** Main bearing journal

[**0046**] **6** Big end bearing journal

[**0047**] **7** Rotational axis of drive device

[**0048**] **8** Deep-rolling machine

[**0049**] **9** Scissor arm

[**0050**] **10** Scissor arm

[**0051**] **11** Scissor rotational point

[**0052**] **12** Drive device

[**0053**] **13** Deep-rolling roller head

[**0054**] **14** Backing roller head

[**0055**] **15** Adjustment cylinder

[0056] **16** Force device

[0057] **17** Hinge point

[0058] **18** Axis

[0059] **19** Angle lever

[0060] **20** Piston cylinder unit

[0061] **21** Backing roller

[0062] **22** Backing roller

[0063] **23** Deep-rolling roller

[0064] **24** Deep-rolling roller

[0065] **25** Oil collar

[0066] **26** Oil collar

[0067] **27** Axial guide

[0068] **28** Axial guide diameter

[0069] **29** Width of backing roller head

[0070] **29***a* Distance of oil collars

[0071] **30** Space

[0072] **31** Space

[0073] **32** Backing roller axis

[0074] **33** Backing roller axis

[0075] **34** Plane through axes **32** and **33**

[0076] **35** Counterclockwise swivel movement

[0077] **36** Clockwise swivel movement

[0078] **37** Acute angle

[0079] **38** Direction

[0080] **39** Prismatic body

[0081] **40** Chamfered edge

[0082] **41** Longitudinal axis

[0083] **42** Socket screw

[0084] **43** Lateral sliding body

[0085] **44** Countersunk bolt

[0086] s Lateral spacing

1. Deep-rolling device of a deep-rolling machine for crankshafts designed in scissor construction with two swivellable scissor arms lying opposite each other, each carrying a deep-rolling roller head or a backing roller head respectively, where the backing roller head is fitted with two parallel-axisly arranged backing rollers of which the rotational axes lie in a common plane, with a drive device which generates the closing and opening movement of the deep-rolling machine and the deep-rolling force, wherein the backing roller head has at least one axial guide

which in swivel direction is arranged in front of the backing rollers to close the scissor arm carrying the backing rollers,

the longitudinal axis of which is perpendicular to the rotational axis of the crankshaft and lies in a direction which encloses an acute angle with the plane of the rotational axes of the backing rollers, and

the axial width of which is greater than the width of the backing roller head and slightly less than the distance of the oil collars of a main bearing journal or big end bearing journal.

2. Deep-rolling device according to claim 1, wherein the acute angle is 0° and the longitudinal axis of the axial guide has a distance from the plane.

3. Deep-rolling device according to claim 1, wherein the axial guide has a contour which is prismatic, cylindrical, crowned or composed of different geometric sections.

4. Deep-rolling device according to claim 1 wherein several axial guides are allocated to each of two backing rollers, the axial width of which guides is less than the width of the backing roller head and the outer width of which is slightly less than the distance of the oil collars of a main bearing journal or big end bearing journal.

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