

Device and method for the machining of crankshaft
journals

5 The invention relates to a mobile device for the machining of crankshaft journals on crankshafts in accordance with the preamble of Patent Claim 1, and also to a method which is to be applied with this device, according to Claims 18 to 20.

10 Devices are generally known consisting of two divided rotating rings which are provided on the outer circumference with a sprocket-wheel toothed arrangement and are held and guided radially on the transition grooves between the crankshaft journals by sliding
15 blocks made of plastic. The drive takes place by means of a motor which is driven by compressed air, via a roller chain which has been placed around one of the rotating rings. The other rotating ring is connected to the driven rotating ring by spacer rods which can be
20 screwed in. The machining of the running surface takes place with the rotating rings revolving, by means of a compressed-air grinding machine which is fitted onto the device and is equipped with a cup wheel. The finish-machining can take place by means of an orbital
25 grinder fitted on the device, or manually by filing or by abrasive-grinding. After that the transition grooves have to be reset using manually guided radial grinding machines driven by compressed air.

 Because of the low removal efficiency during
30 grinding, this method is uneconomical, and because of the contamination of the operating area with grinding dust which is detrimental to health, a large outlay for cleaning work is necessary.

 The imprecise guiding and the play, which
35 increases with the machining time, in the sliding blocks in the transition grooves means that a large overmeasure has to be provided which is finished by complex, manual work and with reduced manufacturing quality and with a high expenditure on time.

The construction of the device and also the alignment on the crankshaft journal are time-consuming, and because of the compressed-air hose which follows it and automatically coils up, a continuous working
5 sequence is not possible, since the direction of rotation of the device has regularly to be reversed in order to uncoil the hose.

DE 34 34 140 indicates a device which is
suspended on a mount and is supported on the crankshaft
10 journal by means of rollers or sliding blocks. The device follows the revolving crankshaft journal on account of the mount and is always kept in a plane-parallel position with respect to the crankshaft central journal by an electronic spirit level. The
15 machining takes place by means of a driven grinding cylinder.

In addition to the above-described disadvantages of the grinding method, in this device there is a risk of inaccuracies during the controlled
20 parallel alignment if vibrations or oscillations occur in the vicinity of the said device, and so the manufacturing quality is reduced when used, for example on ships. Furthermore, the main bearings of the crankshaft are stressed by the revolution during the
25 machining and may be damaged.

German Utility Model 77 09 500 has disclosed a device consisting of a stationary, dividable outer ring which is fastened to the crankshaft web in an axially and radially adjustable manner. Mounted rotatably in
30 this outer ring is a transmission-driven carrier ring which carries an axially displaceable slide on a guide. Fastened to this slide is a cutter for the machining of the crankshaft journal, the said cutter being displaced along the running surface by an advancing device.

35 The construction and the installation of this device are very complicated, and a high expenditure on time is necessary to precisely adjust the fixed outer ring.

The object of the invention is to provide a mobile device and a method for the simple, rapid and precise machining of crankshaft journals on crankshafts.

5 According to the invention, this object is achieved by the characterizing features of Patent Claim 1 and also by a method having the features of Patent Claims 18 to 20.

10 The machining method applied with the device achieves the dimensional, shape and positional tolerances specified in terms of the design, and also the required surface finishes to such an extent that only a small amount of manual finishing work is required comparable in extent with that which is
15 necessary when manufacturing from new.

 The particularly advantageous, simple installation and handling of the device achieve a considerable saving on time for the machining, thereby resulting in an overall increase in the economic
20 efficiency of the machining.

 The favourable reduction in the volume of chips during the finish-machining means that the yield of grinding dust which is detrimental to health is virtually completely eliminated.

25 The particularly advantageous fastening of the device can do without bores, so that after the machining there is no reduction in the strength of the crankshaft due to material being taken away or due to changes in the properties of the material. In
30 particular, reworking of damaged crankshaft journals (for example having hardened surfaces) to a constructionally permissible undersized diameter on crankshafts incorporated in the engine is possible.

 In the following, the invention is explained in
35 greater detail with reference to an exemplary embodiment which is illustrated schematically. In the drawings:

Fig. 1 shows an embodiment of the device according to the invention in front view,

Fig. 2a shows the device according to Fig. 1 as a side view,

5 Fig. 2b shows the device according to Fig. 1 in a section through a crankshaft journal,

Fig. 3 shows the application of the device according to Figs. 1 and 2 on a crankshaft installed in an engine.

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Fig. 1 shows a detail of a crankshaft (2) having a crankshaft central journal, which is illustrated in truncated form, and having a crankshaft journal (3) bounded by crankshaft webs. Transition
15 grooves (20) are made at the transitions from the running surface of the crankshaft journal (3) to the crankshaft webs.

The device (1) is fastened by in each case one divided inner ring (6) to the side surfaces of the two
20 crankshaft webs which are positioned concentrically with respect to the crankshaft-journal axis by fixing segments (8). These fixing segments (8) each have a concave rounding on the surfaces which are in contact with the running surface of the crankshaft journal (3),
25 the said rounding being matched exactly to the running surface. In a preferred design, two fixing segments (8) are in case releasably screwed to the upper and lower half of the inner rings (6). When the machining method is being carried out, the said fixing segments are not
30 removed until that boundary region, which they cover, of the running surface is machined, since up until this point the said fixing segments (8) can be used for additional radial fixing. For different journal diameters, corresponding fixing segments (8) having
35 matching roundings have to be produced.

In a preferred design, the inner rings (6) are fixed to the inner side surfaces of the crankshaft webs by means of high-power round magnets. These magnets (9) are placed into stepped holes which are situated on a

pitch circle for holes on the lower half of the divided inner rings (6) and, with regard to bore diameter, number and diameter of the pitch circle for holes, are optimized in such a manner that a maximum adhesive
5 force of the magnets (9) is exerted onto the web side surfaces. A further method of fastening the inner rings (6) makes use of an adhesive which is applied between the inner rings (6) and the web side surfaces and whose adhesive action can be cancelled, for the purpose of
10 removing the device (1), by a chemical solvent enabling the adhesive to be removed without leaving a residue.

The orthogonal alignment of the inner rings (6) with respect to the crankshaft main axis and the parallel alignment of the two inner rings (6) with
15 respect to each other take place via a plurality of stud bolts (26) which are screwed into threaded bores on the inner rings (6) and are positioned against the web side surfaces. The device (1) is thereby additionally secured against being displaced radially
20 when the fixing segments (8) are removed.

The position of the two inner rings (6) is checked via dial gauges (12, 21). Radial displacement is indicated by a dial gauge (12) which is fastened, for example with a magnetic holder, to that region of
25 the inner ring (6) protruding over the crankshaft web, and the tip of the said gauge is positioned on the crankshaft-web outer side in the radial direction. An axial change in position is monitored by a further dial gauge (21) which is fixed to the crankshaft-web outer
30 surface by means of a magnetic holder or other fastening means and the gauge tip of which is positioned against the protruding region of the inner ring (6) in the axial direction.

A plurality of protruding rollers (7) serving
35 for the play-free guidance of rotating rings (4) placed on them are embedded on the circumferential surfaces of the inner rings (6). For this purpose, use is preferably made of commercially available grooved ball bearings which take over both the function of a

play-free mounting on rolling bearings and also the guidance on their outer ring. The rollers (7) are mounted unevenly split around the outer circumference of the inner rings (6) in order to avoid a situation in which the opposed joltings of the divided rotating rings (4) run at the same time over opposite rollers (7). The rollers (7) enable the rotating rings (4) to be guided in a play-free manner both in the axial direction and in the radial direction.

10 Sealing elements, not shown in more detail, are provided between the inner rings (6) and the rotating rings (4) in order to protect the rollers (7) from contamination.

15 The rotating rings (4) which are present on both sides are connected to one another by spacer plates (11), and the drive for the rotational movement takes place by means of a roller chain (19) which has been placed over the integral toothed arrangement (5). This toothed arrangement (5) may also be situated on an additional ring which is pressed by the rotating rings (4).

 The spacer plates (11) which are circumferentially opposite one another are in each case screwed to the rotating rings (4) with angle sections.

25 An advancing device (14) is installed on one of the preferably two spacer plates (11), the said advancing device being moved along the axis of the crankshaft journal (3) by means of a spindle (15). In the preferred embodiment, the spindle (15) is a threaded spindle which is mounted at its two ends in a rotatable, but axially fixed manner, in the rotating rings (4). Mounted on the spindle (15) at a small distance from one rotating ring (4) is a star-shaped driver (16) which - once per revolution of the rotating rings (4) - meshes with an advancing finger (22), which is fastened to the corresponding inner ring (6), as a result of which the spindle (15) is rotated through an adjustable angle. Interacting with the spindle (15) is a spindle nut which is placed into an advancing element

(37). The advancing element (37) protrudes through an aperture on the spacer plate (11), the said aperture extending over the entire displacement path, and is connected to a plate (24). The plate (24) is guided by means of slides (23) in a play-free manner on linear guides (13) which are fastened to both sides of the aperture on the spacer plate (11) along the displacement path. The linear guides (13) are preferably mounted on the lower side, i.e. on that side of the spacer plate (11) which faces the running surface to be machined. Fastened to the plate (24) is a holder (25) which carries an adjusting element (17). The main axis of the adjusting element (17) is preferably aligned at an angle of 30° with respect to the rotational axis of the crankshaft journal (3). However, this position of the adjusting element (17) may also assume another angle of between approximately 0 and 90° . In the preferred design, a commercially available fine-hole collet having adjusting rates of, for example 0.01 mm, is provided as the adjusting element (17). A cutting material (18) with which the rotational machining is undertaken is fastened to the adjusting element (17). Suitable cutting materials (18) include reversible cutting tips, lathe tools and the like made of super-speed steel, hard metal or ceramic cutting materials.

A compressed-air grinding machine, as is known from the prior art, or a milling device having a driven milling tool, for example an inserted-tooth face-milling cutter, may also be attached to the holder (25).

These grinding or milling devices may also be fastened directly to a spacer plate (11), and in this design, after finishing a machining circuit on the circumference of the crankshaft-journal running surface, have to be offset in the axial direction to machine a further circuit. These devices can be fastened in the same manner as for the abrasive-grinding device (38) which is illustrated.

The abrasive-grinding device (38) consists of a shaped block (29) having, on the engagement surface, a concave shape which is matched to the cylindrical surface of the crankshaft journal (3). The engagement surface is covered by abrasive-grinding cloths or similar materials, as are customary for surface finishes. The shaped block (29) is connected to the spacer plate (11) by threaded rods (28) which are screwed into the latter. The positioning pressure of the shaped block (29) against the running surface can therefore be adjusted, which influences the removal of the material. In order to receive the threaded rods, bores (27) are made in the spacer plate (11) provided for them, the said bores being situated on lines along the crankshaft-journal axis and enabling the shaped block (29) to be offset over the entire width of the running surface of the crankshaft journal (3).

In Figs. 2a and b the device (1) is shown in side views. The arrangement of the fixing segments (8) on the inner rings (6) and also their bearing against the running surface of the crankshaft journal (3) can be seen. Furthermore, the joining points and screw connections for connecting the two halves of the inner rings (6) and the rotating rings (4) are illustrated. The rollers (7) are shown by dashed lines, as an illustration of concealed edges, in order to clarify the unevenly split arrangement of the rollers (7) around the circumference of the inner rings (6). The advancing finger (22) is positioned approximately on the horizontal central plane of the device (1) and can be offset by the mount (30) which is fastened - partially concealed by the rings (4, 6) - to the inner ring (6).

The arrangement of the stud bolts (26) which are provided for the parallel alignment of the inner rings (6) can likewise be seen in this view.

The spacer plates (11) which revolve together with the rotating rings (4) are illustrated in a cut-off manner, with only the linear guides (13) and

the aperture for the advancing element (37) being visible on the spacer plate (11) illustrated at the top. There can be seen on the spacer plate (11) shown at the bottom, as also on the upper one, the front view
5 of the fastening angle and the threaded rods (28) for fastening the shaped block (29) which bears with its concave shape against the crankshaft journal (3).

The revolving movement is driven by a motor (33) by means of the roller chain (19) which is wrapped
10 around the toothed arrangement (5) of the one rotating ring (4). This motor is preferably a motor which is operated by compressed air and has an interchangeable ratio of transmission to the chain pinion (32) which - for the purpose of tensioning the roller chain
15 (19) - is fastened in a longitudinally displaceable manner independently of the device (1). Electric motors or other drives are also conceivable. The drive can take place both on the left-hand or right-hand rotating ring (4) - see Fig. 1 - or else simultaneously on both
20 rotating rings (4) by means of two drive units (33, 32, 19, 5).

In order to damp any transverse oscillations which occur on the roller chain (19) and/or in order to pretension the said roller chain, a tensioning device
25 (31) acting together with damping means may be provided.

As an advantage which is to be particularly emphasized, mention should be made of the fact that the device according to the invention and the method can be
30 applied to a crankshaft which is installed in the engine.

The application of the mobile device (1) to a crankshaft (2) incorporated in the engine frame (34) of an internal combustion engine can be understood by
35 reference to Fig. 3.

A truncated illustration shows an engine frame (34) which is connected at the base of its insertion point, for example, to a ship's hull or in the engine room of a power station. The coverings of the openings

(35), which are situated along the cylinder in the regions of the crankshaft journals, have been removed.

The motor (33) for the drive of the device (1) is fastened outside the engine frame (34) on an installation rack, not shown, and drives the device by the roller chain (19).

Illustration of the main bearings of the crankshaft (2) and of all other internal combustion engine parts which are not relevant to the invention has been omitted.

In order to machine a crankshaft journal (3), first of all those halves of the inner rings (6) on the crankshaft journal (3) which are provided with the fixing segments (8) are screwed to one another, are aligned and are fixed to the respective web side surface. After that, the halves of the rotating rings (4) are placed onto the inner rings (6) and likewise screwed fixedly to one another. In the process, the spindle (15) and the spacer plate (11) are already inserted together with the advancing unit (14) but only after their alignment are they fixed to the rotating rings (4) which are already screwed in. A further spacer plate (11) is first of all mounted without the abrasive-grinding device (38). After the drive (19, 32, 33, 31) is mounted, the machining of the running surface of the crankshaft journal (3) can be begun. The cutting material (18) is fed to a bore (36) in the crankshaft journal (3), the said bore serving to supply lubricant. The device (1) is then set into operation and the running surface is machined starting from the bore (36) in the one axial direction until in the vicinity of the fixing segments (8). After that, the holder (25) is turned through 180° on the plate (24) and the running surface is machined starting from the same bore in the other axial direction in the same way as described above.

In order to machine the boundary regions of the running surface of the crankshaft journal (3) the fixing segments (8) are removed and the machining takes

place starting from a bore (36) in the vicinity of the boundary, in the same manner as described above.

After the rotational machining there is still an overmeasure of a few 1/100 millimetres on the running surface which is finish-machined by the
5 abrasive-grinding device (38).

For this purpose, the shaped block (29) which is provided with abrasive-grinding materials is positioned against the running surface and moved over
10 the running surface by the device (1). In order to machine the entire running surface in its axial extent, the shaped block (29) has to be offset in the axial direction by approximately its own width. This takes place by means of the threaded rods (28) which are
15 screwed into the corresponding bores (27) which are mounted in an axially offset manner. The machining therefore takes place stepwise in circuits.

Finally, the transition grooves (20) on both sides of the running surface are reset by a shaping
20 tool preferably being mounted on the holder (25) or on the adjusting element (17). The transition grooves (20) are then machined by stepwise adjustment of the shaping tool. The shaping tool can also consist of a plurality of shaped segments which are positioned and adjusted at
25 the corresponding locations of the transition grooves (20).

The final finish-machining of the transition grooves (20) takes place manually, once the device (1) has been removed, as is also customary in the case of
30 new constructions, but they can also be machined with the device (1) by means of a grinding machine which is mounted on one of the spacer plates (11) and is operated by compressed air or electrically.

In order to carry out the machining methods,
35 the device (1) can be mounted both on crankshafts (2) which are incorporated into in-line engines and into V-engines, or else on removed crankshafts (2).

To apply the device (1) to different crankshafts (2) of different types of engine, the

device (1) can be adapted to the differing dimensions by interchanging the spacer plate (11) with the linear guide (13), and also the spindle (15), the spacer plate (11) with the bores (27), and the fixing segments (8).



Patent Claims

1. Mobile device for the surface machining of
5 crankshaft journals on crankshafts, having revolving
rotating rings and having a tool which can be moved in
the axial direction of the crankshaft journal,
characterized in that the revolving rotating rings (4)
are guided on inner rings (6) which can be positioned
10 radially on the running surface of the crankshaft
journal (3) by means of fixing segments (8) and can be
fixed to the web side surfaces of the crankshaft
journals (3).
2. Device according to Claim 1, characterized in
15 that the radial position of the inner rings (6) can be
changed with respect to the running surface of the
crankshaft journal (3).
3. Device according to Claim 1, characterized in
that the fixing segments (8) can be removed.
- 20 4. Device according to Claim 1, characterized in
that the inner rings (6) can be fixed to the web side
surfaces of the crankshaft journals (3) by means of
magnets (9).
5. Device according to Claim 1, characterized in
25 that the inner rings (6) can be fixed to the web side
surfaces of the crankshaft journals (3) by means of
chemically soluble adhesive.
6. Device according to Claim 1, characterized in
that the inner rings (6) are fastened to the
30 crankshaft-web outer contour by supporting elements
(10).
7. Device according to Claim 1, characterized in
that the inner rings (6) can be aligned parallel to one
another by means of stud bolts (26) positioned against
35 the crankshaft-web side surfaces.
8. Device according to Claim 1, characterized in
that the rotating rings (4) can be fixed with respect
to one another by means of spacer plates (11).



- 9 Device according to Claim 8, characterized in that an advancing unit (14) is provided on at least one of the spacer plates (11), the said advancing unit displacing the tool (18) axially by means of a spindle
- 5 (15) which, with each full revolution of the rotating rings (4), is rotated further through an adjustable angle by means of a fixed advancing finger (22).
- 10 10. Device according to Claim 1, characterized in that the axial and radial position of the inner rings
- 10 (6) can be checked by means of dial gauges (12, 21) during operation of the device.
11. Device according to Claim 1, characterized in that cutting material (18) for the rotational machining is attached as the moveable tool.
- 15 12. Device according to Claim 11, characterized in that a fine-hole collet, whose main axis is at an angle of between approximately 0 and 90° with respect to the rotational axis of the crankshaft journal (3), is provided as the adjusting element (17) for the cutting
- 20 material (18).
13. Device according to Claim 1, characterized in that a driven grinding machine is attached to a spacer plate (11).
14. Device according to Claim 8, characterized in
- 25 that a milling device which can be offset in the axial direction is provided on at least one of the spacer plates (11), for the rotational milling.
15. Device according to Claim 8, characterized in that an abrasive-grinding device (38) which can be
- 30 offset in the axial direction is provided on at least one of the spacer plates (11).
16. Device according to Claim 1, characterized in that the rotating rings (4) can be driven by a pneumatic or electric motor (33) by means of a roller
- 35 chain (19) which can be pretensioned by a tensioning device (31).
17. Device according to Claim 1, characterized in that the rotating rings (4) are guided by rollers (7)



which have rolling bearings and are mounted unevenly split around the circumference of the inner rings (6).

18. Method for the machining of crankshaft journals (3) using the device according to one of the preceding
5 claims, characterized in that the running surface of the crankshaft journal (3) and the transition grooves (20) are rough-turned with an overmeasure, the fixing segments (8) for the machining of the boundary regions
10 of the running surface being removed and then the running surface being finish-machined by aggressive grinding into shape using the device, and finally the transition grooves (20) are finish-machined.

19. Method according to Claim 18, characterized in that the transition grooves (20) are finish-machined
15 manually after the device (1) has been removed.

20. Method according to Claim 18, characterized in that the transition grooves (20) are finished-machined by the device (1) by means of a grinding machine.

21. Method according to Claim 18, characterized in
20 that a driven milling tool is used for the rotational machining.

22. Method according to one of Claims 18 to 21, characterized in that the method is carried out in the engine with the crankshaft installed.