

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: 82305151.1

(51) Int. Cl.³: B 24 B 5/42

(22) Date of filing: 29.09.82

(30) Priority: 07.10.81 US 309217

(43) Date of publication of application:
13.04.83 Bulletin 83/15

(84) Designated Contracting States:
DE FR GB IT

(71) Applicant: LITTON INDUSTRIAL PRODUCTS, INC.
East Sixth Street
Waynesboro Pennsylvania 17268(US)

(72) Inventor: Shank, William E.
77 Briar Ridge Drive
Waynesboro Pennsylvania 17267(US)

(74) Representative: Warren, Anthony Robert et al,
BARON & WARREN 18 South End Kensington
London W8 5BU(GB)

(54) Crankpin grinding machine.

(57) A cylindrical grinding machine for grinding a pair (P1, P2) of axially and angularly offset crankpins (P1 to P6) on a crankshaft having a plurality of main bearings comprises a grinding wheel assembly including a grinding wheel for effective stock removal from a crankpin having a selected axial location and rotatively driven about a predetermined axis (A1). The machine also includes axial displacement means for presenting one (P2) of the crankpin pair (P1,P2) to be ground at the selected axial location with the axis of the one crankpin coaxial with the predetermined axis (A1), a workholding fixture (12) including chuck means for clamping a crankshaft placed therein, and means for presenting the other one (P1) of the crankpin pair (P1,P2) to be ground with the axis of the other crankpin coaxial with the predetermined axis (A1). The presenting means includes a spindle housing (23), a first spindle (16) rotatably supported within the spindle housing (23), a second spindle (14) eccentrically supported within the first spindle (16) for rotation therein, the workholding fixture (12) being secured to the second spindle (14) with the axes of rotation of both pins (P1, P2) of the pin pair (P1,P2) being equidistant from the axis of rotation (A2) of the second spindle. An indexing means is provided for rotating the second spindle (14) relative to the first spindle (16) a degree selected to locate the axis of the other pin (P1) coaxial with the axis of rotation (A1) of the first spindle (16).

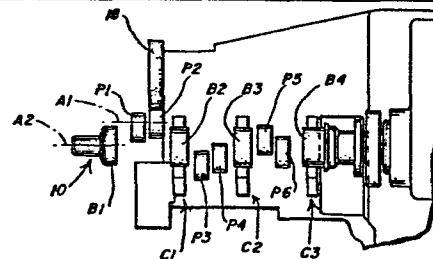


Fig. 1

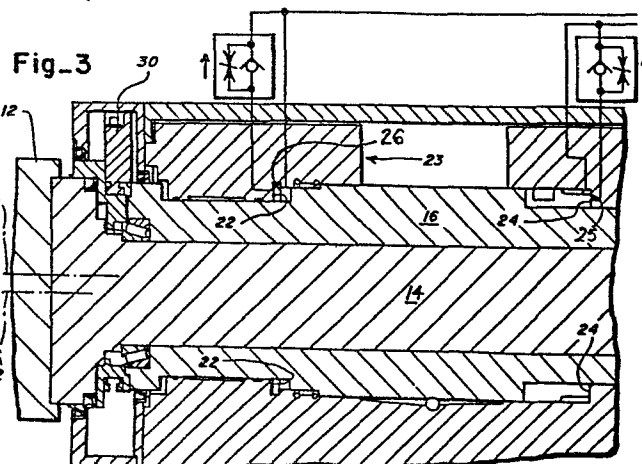


Fig. 3

CRANKPIN GRINDING MACHINE

5 The crankpins of a crankshaft may be ground by sequentially transferring the crankshaft through a series of cylindrical grinding machines each dedicated to the grinding of one of the crankpins. Such a crank transfer line of crankpin grinding machines, as disclosed in U.S. Patent Nos. 4,003,721, 4,030,721 and 4,033,076, includes a plurality of cylindrical grinding machines each having a single rotatable grinding wheel
10 for effecting stock removal from a crankpin having a selected axial and rotary position. The crankhead assembly of each such machine includes a clamping fixture which selectively clamps one end of the crankshaft on each of the plurality of main bearings
15 leading to the crankpin to be ground.

It is an object of the present invention to provide an improved cylindrical grinding machine which is ideally suited for inclusion in such a transfer line having an indexable crankhead assembly for sequentially
20 locating a pair of angularly and axially offset crankpins of a crankshaft at a predetermined location for stock removal by the grinding wheel.

Other objects and advantages of the present invention will become apparent from the following
25 portion of the specification and from the accompanying drawings which illustrate a presently preferred

embodiment incorporating the principles of the invention.

Referring to the drawings:

30 Figure 1 is an elevational view of the headstock assembly of a crankpin grinding machine made in accordance with the teachings of the present invention;

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Figure 2 is a schematic axial view of the headstock assembly.

Figure 3 is an elevational view in section of the spindle assembly for the headstock assembly shown in Figure 1;

Figure 4 is an elevational view of the rotary indexing mechanism of the spindle assembly shown in Figure 3; and

Figure 5 is an elevational view of the stop gear of the indexing mechanism shown in Figure 4.

A cylindrical grinding machine effects stock removal from a cylindrical workpiece, such as a crankpin on a crankshaft 10 schematically shown in Figures 1 and 2. Instead of the normal three 120° related crankpins, the illustrated V6 crankshaft has three pairs (P1, P2), (P3, P4), (P5, P6) of 120° related crankpins with the pins of each pair being offset by 30° . The crankshaft includes four coaxial main bearings B1, B2, B3, B4, the inboard three of which are secured within clamping fixtures C1, C2, C3 of a crankhead assembly 12. Radially indexing a crankshaft while clamped in the clamping fixtures is disclosed in U.S. Patent No. 2,454,186.

The crankhead assembly 12 is secured to an inner spindle 14 (Figure 3) which is located eccentrically within an outer spindle 16. The inner spindle 14 is normally fixed relative to the outer spindle 16, but is capable of being rotated relative thereto. The outer spindle 16 is supported for rotational and axial movement in a spindle housing 23 via a hydrostatic bearing arrangement.

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Rotatably driving the outer spindle will, accordingly, effect rotation of the workpiece about the outer spindle axis A1 which is coaxial with the axis of crankpin P2 at a location where advancement of a rotating grinding wheel 18 can effect stock removal from that crankpin.

At the conclusion of stock removal from the crankpin P2, the other pin P1 of the crankpin pair will be located at the axial and radial grinding position by selectively axially and radially indexing the workpiece.

Axial indexing is effected by axially displacing the outer spindle 16 to the left, from its position shown in Figure 3 whereat an outer spindle shoulder or collar 25 abuts against a right-hand thrust face 24 of the hydrostatic bearing in the housing 23, to a position whereat an outer spindle shoulder or collar 26 abuts against a left-hand thrust face 22 of the hydrostatic bearing. Axial displacement of the outer spindle 16 is effected by hydraulic actuator circuitry (shown diagrammatically), which communicates with recesses or fluid reservoirs in the outer spindle 16 and opening into the shoulders or collars 25 and 26. The faces 24, 22 and shoulders or collars 25, 26 are axially located so that the distance of axial movement of the outer spindle corresponds to the axial spacing of the two pins P1, P2 of the pin pair to be ground.

The angular indexing of the workpiece is achieved by an indexing mechanism which rotates the inner spindle 14 about its axis A2 between first and second predetermined angular positions relative to the outer

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spindle and which maintains the inner spindle at either of these two positions. A single counter-weight 30 is secured to the outer spindle opposite the axis A2 of the eccentric inner spindle to balance
5 the spindle assembly.

An indexing assembly 50 is secured to the right-hand end of the outer spindle 16 and includes redundant or duplicated gear drive mechanisms operatively associated with a driven gear 52 secured to
10 the inner spindle 14. Each gear drive mechanism includes a hydraulic motor 54 including a rack member 56 which is operatively engaged with a pinion gear 58. A bar link 60 interconnects each pinion gear 58 with an associated gear 62 which drives gear 64 so as to
15 step-up the displacement of the rack. A gear 66, which is concentric to and operably connected to with gear 64 is operatively connected to the driven gear 52 which drives the inner spindle.

The driven gear 52 includes a stop mechanism
20 which has two semicircular channels 70 ending with an end stop surface 72. First and second stop pins 74 (Figure 4) tangentially engage the stop mechanism of the gear 52 within the two channels. When the inner spindle is rotated in a first direction, the
25 first stop pin 74 will engage the end stop surface 72 of the first channel to define the first angular position of the inner spindle, and when the inner spindle is rotated in a second direction, the second stop pin will engage the second channel stop surface
30 to define the second angular position of the inner spindle.

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CLAIMS

1. A cylindrical grinding machine for grinding a pair of axially and angularly offset crankpins (P1 to P6) on a crankshaft (10) having a plurality of main bearings (B1 to B4), comprising a grinding wheel assembly including a grinding wheel (18) for effective stock removal from a crankpin having a selected axial location and rotatively driven about a predetermined axis, means for presenting one (P2) of the crankpin pair to be ground at said selected axial location with the axis of the one crankpin coaxial with the predetermined axis (A1), characterised by
- 5 a workholding fixture (12) including chuck means (C1, C2, C3) for clamping a crankshaft (10) placed therein, and
- 10 means for presenting the other one (P1) of the crankpin pair to be ground with the axis of the other crankpin coaxial with the predetermined axis (A1) including
- 15 a spindle housing (23),
- 20 a first spindle (16) supported by said spindle housing,
- a second spindle (14) eccentrically supported within said first spindle for rotation therein, said workholding fixture being secured to said second spindle
- 25 with, in use, the axes of rotation of both pins of the pin pair being equidistant from the axis of rotation (A2) of said second spindle, and
- means for rotating (50) said second spindle relative to said first spindle a degree selected to
- 30 locate the axis of the other pin coaxial with the axis of rotation (A1) of the first spindle.

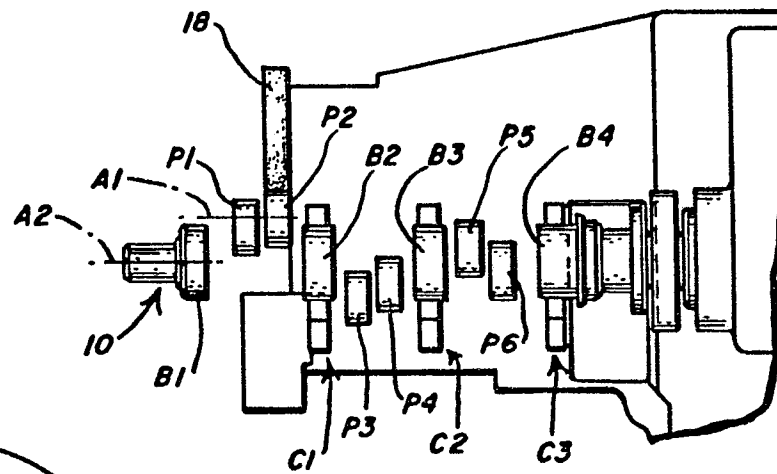


Fig. 1

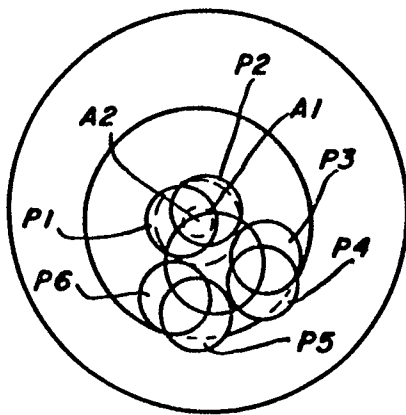


Fig. 2

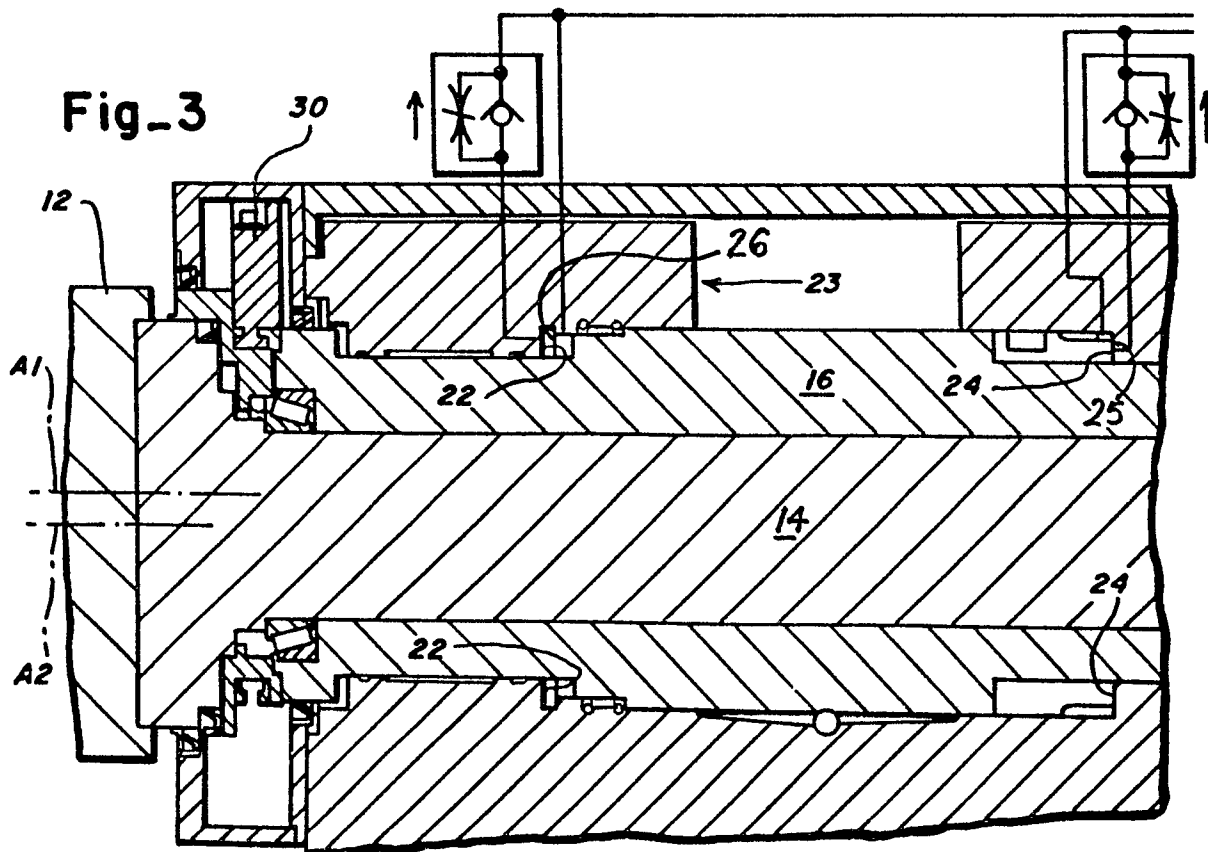


Fig. 3



European Patent
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EUROPEAN SEARCH REPORT

0076635

Application number

EP 82 30 5151.1

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>US - A - 3 584 423</u> (S.W. HOARE) * claim 1; fig. 1 to 3 * ---	1	B 24 B 5/42
A	<u>US - A - 3 142 941</u> (R.H. FOURNIER et al.) * claim 1; fig. 1, 2 * ---	1	
A	<u>US - A - 2 651 895</u> (H.N. ROCKS) * claim 1; fig. 1 to 4 * ---	1	
A	<u>US - A - 4 030 252</u> (R.E. PRICE) ---		TECHNICAL FIELDS SEARCHED (Int.Cl. 3)
D,A	<u>US - A - 4 003 721</u> (R.E. PRICE et al.) ---		B 23 B 5/00
D,A	<u>US - A - 4 033 076</u> (R.E. PRICE) ---		B 24 B 5/42
D,A	<u>US - A - 2 454 186</u> (E.D. LA FLEUR) -----		B 24 B 41/06
			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
X The present search report has been drawn up for all claims Place of search Berlin Date of completion of the search 28-12-1982 Examiner MARTIN			