(12) UK Patent Application (19) GB (11) 2 200 306 (13) A

(43) Application published 3 Aug 1988

(21) Application No 8728578

(22) Date of filing 7 Dec 1987

(30) Priority data
(31) 9160/86 (32) 11 Dec 1986 (33) CS

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(51) INT CL⁴
B24B 5/06

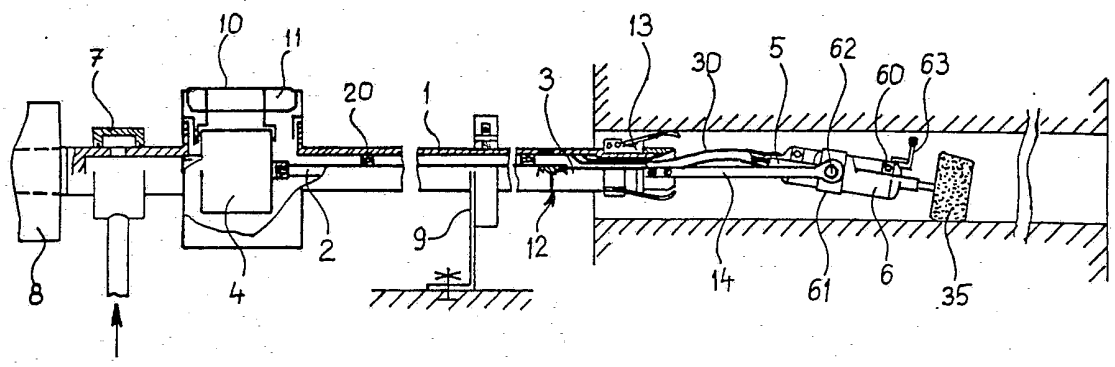
(52) Domestic classification (Edition J):
B3D 222 FRX

(56) Documents cited
None

(58) Field of search
B3D
Selected US specifications from IPC sub-class
B24B

(54) Arrangement for the grinding of deep holes

(57) The arrangement comprises a hollow shaft (1) provided with a casing (10) containing drive means (4) to which is connected a rotatable shaft (2) passing through the hollow shaft and mounted there in bearings (20), and a flexible shaft (3) connected to the end of the rotatable shaft and having a jacket (30) which is fixed to the hollow shaft, the terminal part of the flexible shaft being connected to the shaft (5) of a grinding disk (35), the latter shaft being mounted in bearings (60) in a case (6). A sleeve (61) on the case (6) is pivotally mounted on support members (14) fixed to a carrier (13) on the shaft (1).



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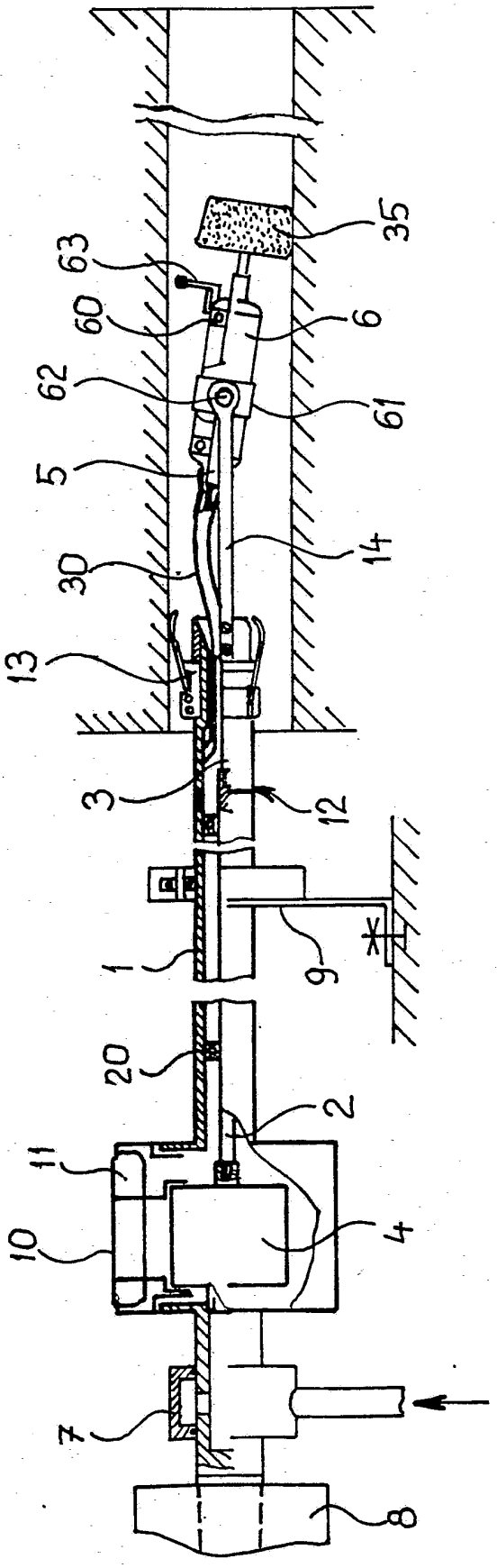

ARRANGEMENT FOR THE GRINDING OF HOLES OF SMALL DIAMETER

The invention relates to an arrangement which can be used either as a mobile tool or as an accessory equipment for machine tools, to be used for final grinding in order to improve the smoothness of the internal surface of holes, particularly deep holes of small diameter.

Honing is at present used solely to improve the smoothness of a ground surface of deep holes of small diameter. Such honing requires a special machine in which rotating movement and rectilinear movement are combined such that the honing head performs a helical movement of a large pitch. This technology ensures high accuracy and smoothness of the worked hole while reducing productivity and increasing investment costs.

It is an object of this invention to reduce substantially these drawbacks by the provision of an arrangement for final grinding of holes of small diameter comprising a hollow shaft with a casing for a drive, a rotatable shaft, a flexible shaft and a drive. According to this invention the casing for the drive is arranged on a hollow shaft where the drive is situated. A rotatable shaft passing through this hollow shaft is connected to the drive, with bearings for the rotating shaft within said hollow shaft. At the end of the rotatable shaft a flexible shaft is connected, the jacket of which is fixed to the hollow shaft. The terminal part of the flexible shaft is introduced into a shaft of the grinding disk which shaft is mounted in bearings in a case.

An advantage of this arrangement for final grinding of holes of small diameter is its

universality of application for final grinding of holes of different diameter of rotational and not rotational parts requiring small investment costs. The smoothness of the surface is better than obtained by boring machines. As by grinding of holes by application of this arrangement according to this invention grooves caused by boring are removed, it is possible to achieve by a following roller burnishing of the surface of the hole better results than by honing, which is of particular interest for a substantial increase of the life time of packing elements of hydraulic circuits. The tool for roller burnishing can be thereby connected to the hollow shaft of the arrangement according to this invention.

One embodiment of an arrangement according to this invention connected to the shaft of a horizontal boring machine will now be described, by way of example, with reference to the accompanying diagrammatic drawing showing the arrangement in sectional elevation.

The arrangement comprises a hollow shaft 1 with a casing 10 for a drive 4, connected to the hollow shaft 1. The casing 10 is provided with a door 11 to enable assembly and checking. The left-hand part of the hollow shaft 1 passes through a power supply 7 and is inserted into a shaft 8 of a machine tool. The hollow shaft 1 passes behind the casing 10 for the drive 4 through a steady 9 which is fixed to a bed (not shown) of the the machine tool. The hollow shaft 1 is for reasons of assembling interrupted by a threaded coupling 12. The right-hand part of the hollow shaft 1 proceeds downstream of said coupling 12 up to a collar with a carrier 13, the feelers of which serve to centre the hollow shaft

1 with respect to the hole. Longitudinal supports 14, fixed to the body of the carrier 13, support, by way of a balancing sleeve 61 and bolts 62 a case 6. The case 6 is provided with bearings 60, supporting a shaft 5 of the grinding disk 35, which case 6 is in the hole stabilized by a stabilizer 63. A rotatable shaft 2 starts at the drive 4, passes through the hollow of the hollow shaft 1 where it is supported in bearings 20 and is at the coupling 12 provided with a thread for its connection to a flexible shaft 3 which terminates by connection with the shaft 5 of the grinding disk 35. A jacket 30 of the flexible shaft 3 is fixed to the internal surface of the hollow carrier 13 at the coupling 12 and its end is connected to the case 6.

An arrangement according to this invention offers, in use, three possibilities of different rotational movements of individual parts. The hollow shaft 1, of course, rotates slowly while the axis of the shaft 8 of the machine tool coincides with the axis of the hole being ground. Either the part with the hole remains at standstill and only the hollow shaft 1 and the grinding disk 35 rotate, the latter performing substantially a planetary movement; or the shaft 8 of the machine tool and the hollow shaft 1 are at standstill and only the part with the hole and the grinding disk 35 rotate together with the shaft 5, the latter however does not perform a planetary movement. Or finally the shaft 8 of the machine tool, the hollow shaft 1 and the part with the hole and the grinding disk 35 rotate, the latter performing in this case also a planetary movement. In the first case the arrangement according to this invention may be used to grind holes of parts which cannot be rotated. The second case concerns for

instance deep boring machines with a non-rotatable shaft. The most accurate hole is obtained in the third case, if this kind of rotation is enabled by the used machine tool.

The arrangement according to this invention is assembled by slipping the power supply 7 on to the left-hand part of the hollow shaft 1, whereafter the left-hand conical part of the hollow shaft 1 is inserted into the conical hollow of the shaft 8 of the machine tool. The hollow shaft 1 is simultaneously inserted into the steady 9. The door 11 of the casing 10 of the drive 4 is opened and the drive 4 is inserted therein. The rotatable shaft 2 is thereafter inserted into the hollow of the hollow shaft 1 and is connected to the drive 4. The door 11 is closed and the flexible shaft 3 with the jacket 30 are inserted into the hollow of the carrier 13 and the end of the shaft 3 is connected to the rotatable shaft 2 while its jacket 30 is fixed to the hollow of the carrier 13. The carrier 13 is connected by the threaded coupling 12 with the hollow shaft 1. The resilient longitudinal supports 14 were before that screwed on the lateral parts of the carrier 13. The centre of gravity of the system of the case 6 and of the grinding disk 35 is thereafter determined, the balancing sleeve 61 is adjusted so that the bolts 62 are in the centre of gravity of said system and the flexible shaft 3 and its jacket 30 are connected to the shaft 5 of the grinding disk 35. The eyelets of the longitudinal supports 14 are spaced apart, are suspended on bolts 62 of the sleeve 61 and secured. The stabilizer 63 is adjusted according to the diameter of the worked hole and is connected to the case 6. The thus assembled arrangement is inserted into the hole, the shaft 8 of the machine tool is

caused to rotate, the feeding is started and thereby also the feeding of the hollow shaft 1 with the carrier 13, the longitudinal support 14 and the case 6. The drive 4 with the rotatable shaft 2, the flexible shaft 3, the shaft 5 of the grinding disk 35 and thus also this grinding disk 35 are started. In order to achieve a higher precision of the arrangement it is suitable to use an introductory appliance from one or from both sides of the hole subject to grinding.

CLAIMS

1. Arrangement for the grinding of holes of small diameter comprising a hollow shaft provided with a casing containing a drive to which is connected a rotatable shaft passing through the hollow shaft and mounted there in bearings and to the end of the rotatable shaft is connected a flexible shaft, the jacket of which is fixed to the hollow shaft, the terminal part of the flexible shaft being connected to the shaft of a grinding disk, the latter shaft being mounted in bearings in a case.

2. Arrangement according to Claim 1 constructed, arranged and adapted to operate substantially as herein described with reference to, and as shown in, the accompanying drawing.

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