Oct. 22, 1940. J. LINDIG 2,219,232

PROFILING ATTACHMENT

Filed Jan. 29, 1937 3 Sheets-Sheet 1

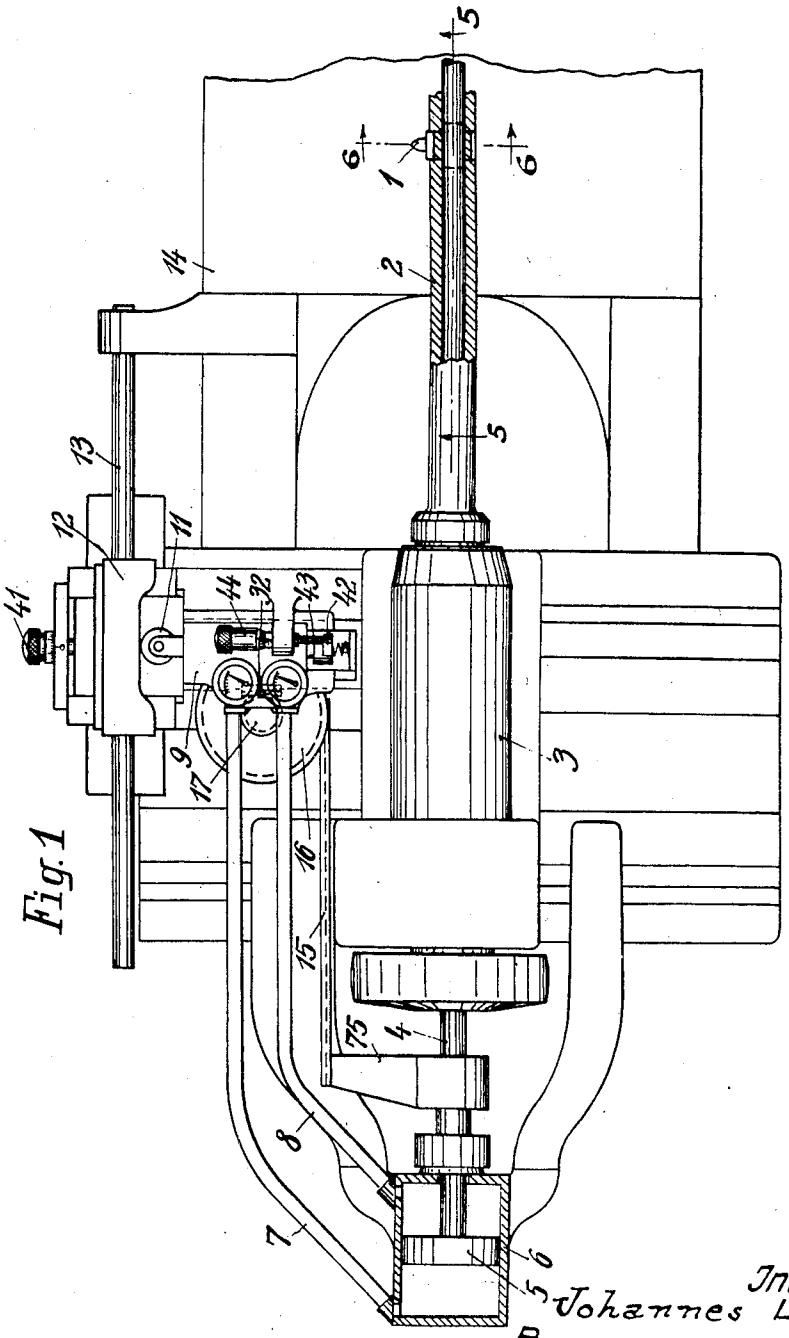


Fig. 1

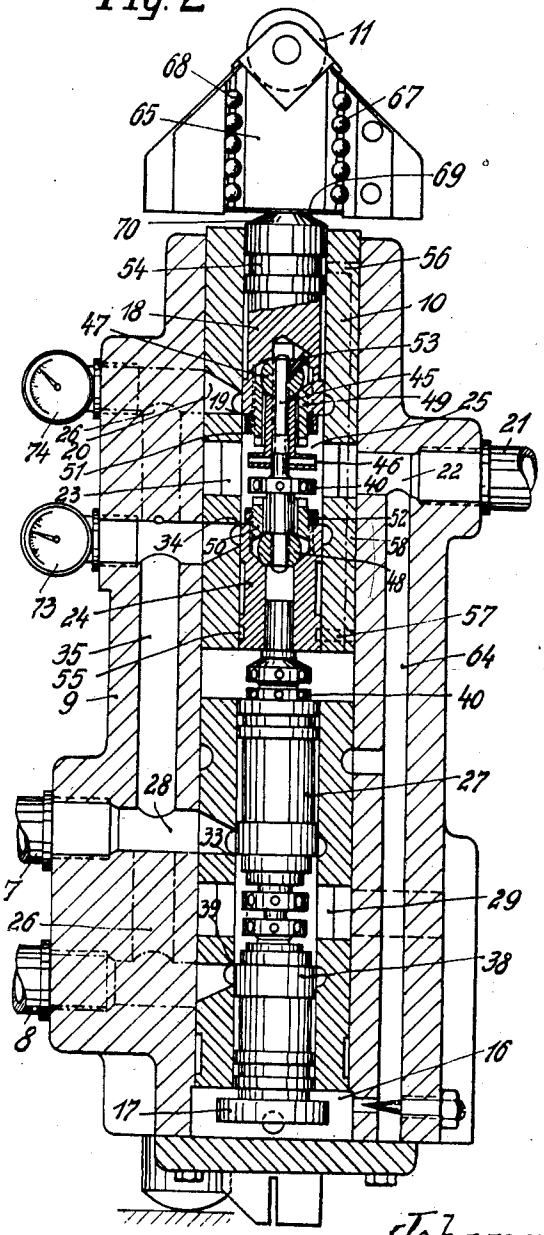
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Fig. 2



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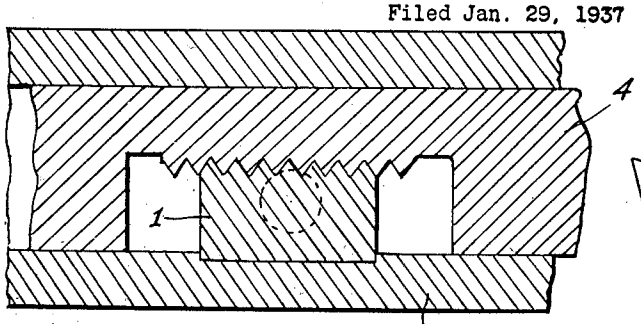


Fig. 5.

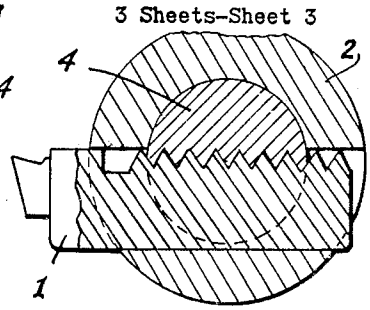


Fig. 6.

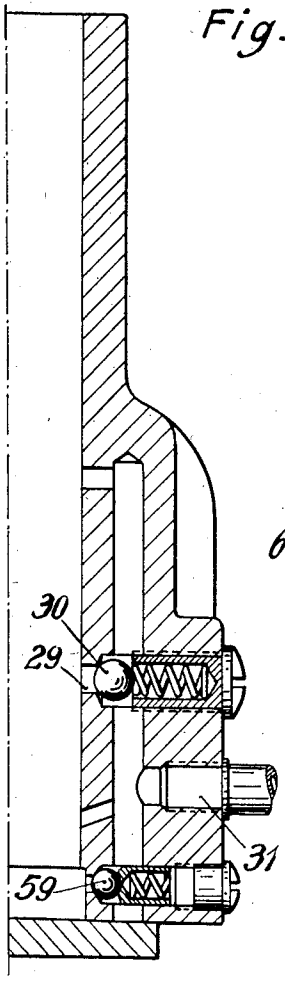


Fig. 3.

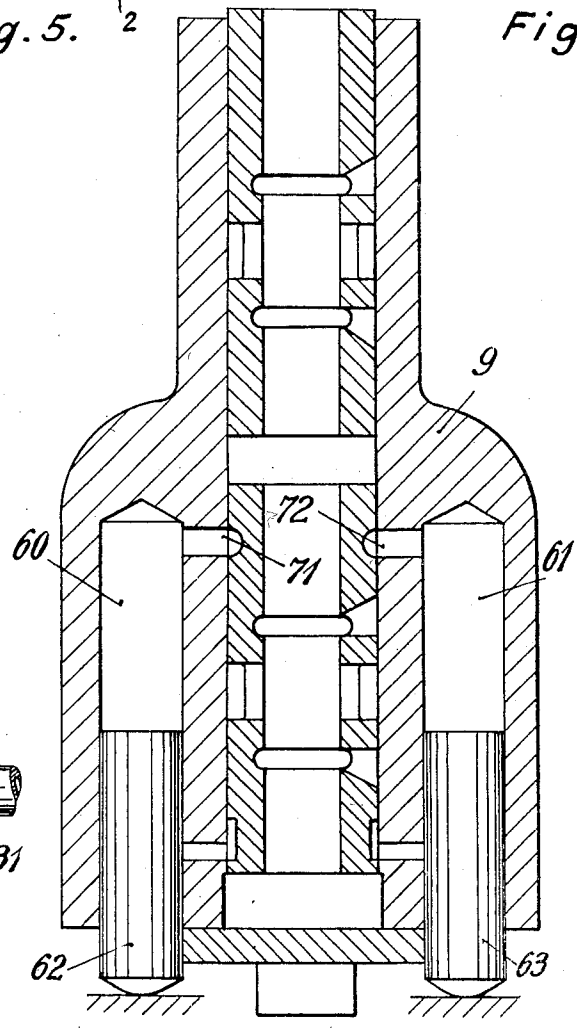


Fig. 4.

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PROFILING ATTACHMENT

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11 Claims. (Cl. 77—3)

This invention relates to an auxiliary power device for transmitting motions of a machine part to another one, preferably in profiling attachments of machine tools, such as fine boring mills. According to the invention motions of a feeler in profiling attachments of fine boring mills can for instance be transmitted with great accuracy and without appreciable delay to the pressure rod arranged in the spindle of fine boring mills and effecting radial adjustment of the tools.

Profiling devices are known already which employ a gage that influences the control valve of an auxiliary power cylinder effecting the feed. The control valve in these known devices is reset by one end of a double-armed lever engaging it, the other end of the lever being moved directly by the feeler influenced by the gage. This arrangement, however, is not suited for carrying out work in the highly accurate manner required in fine boring mills, since the valve which controls the auxiliary power cylinder and the slightest motion of which naturally has a considerable effect upon the feed of the tool is subjected to the action of three swinging or swingable structures, viz., the feeler linkages, the tool with its rods and the return or resetting spring acting directly on the control slide valve. As impulses of motion counteracting one another act on the control slide valve, errors in transmission and oscillations are unavoidable, so that these known devices are unsuited for accurate work.

These drawbacks of the known devices are eliminated according to the invention by controlling the supply of pressure medium to the working cylinder by the motion of a slide valve which is subjected to the action of a template, preferably guided past it by the working table, and arranged in a control casing which is returned by the motion of the machine part adjusted by the working piston. In this manner the accuracy of the resetting motion can be adapted to the requirements of fine boring mills and lost motion eliminated to a very great extent. According to the invention, this last-mentioned object is particularly attained by effecting operative connection between the control casing and the machine part to be controlled, such as a pressure rod, through the form of the parts and subjecting this connection by means of one or more pistons guided in cylinders of the casing and supporting it at regulatable liquid pressure relative to the machine frame to the action of a constant adjustable power. Harmful play, particularly between the control member and the gage or template, is further prevented according to the invention by subjecting the controlling machine part, for instance the control slide valve adjusted by the action of the template, through the medium of a pressure chamber arranged at the lower end of the valve and provided with a regulatable overpressure valve to constant adjustable tension relative to the casing or another part connected with the machine part to be controlled, the tension being taken up by the controlling part, such as the template.

The application of the invention to the control of, say, multi-spindle profiling attachments in fine boring mills can be facilitated according to the invention by causing the piston, for the purpose of controlling several machine parts at the same time, to be connected with a pressure plate which is engaged by the machine parts to be controlled, such as the pressure rods. Operative connection between the control casing and the machine part to be controlled is preferably effected according to the invention by providing for mechanical connection between the casing and the machine part to be controlled, such as a pressure rod, said mechanical connection comprising in this instance a rack and toothed wheels connected with the rod by a pressure plate and, further, a rack connected with the casing. To avoid irregularities in the motion of the working piston due to the variable working resistance, etc. it is advisable to arrange a regulatable throttle valve in the return piping of the pressure medium. To facilitate the gradual removal of the material, particularly in internal boring, the feeler template is rendered adjustable in a direction perpendicularly to the direction of motion thereof, preferably by means of a micrometer screw. In order to prevent excessive adjustment of the tools especially on boring bars, between the control piston and the feeler roll and control casing an adjustable stop, preferably a micrometer screw, is interposed. Accuracy in feeling the gage is particularly increased by causing the transmission of the motion of the feeler roll to the row of pistons to be effected by means of an intermediate member which is guided between rows of balls arranged in prisms and against the preferably plane front surface of which the curved front face of the extreme piston of the row is seated.

By way of example, one form of the invention as applied to a profiling attachment for fine boring mills is illustrated in the accompanying drawings, in which Figure 1 is a total view of the entire device; Fig. 2, a longitudinal section of the control device; Fig. 3, a sectional detail view of the

control casing; Fig. 4, a further sectional detail view of the control casing; Fig. 5 is a sectional view taken on line 5—5 of Fig. 1; and Fig. 6 is a sectional view taken on line 6—6 of Fig. 1.

In the construction shown, the boring spindle 2 provided with the boring tools 1 is arranged in the spindle head 3. For radial adjustment of the boring tools 1 the hollow spindle 2 contains an axially displaceable pressure rod 4 which effects radial adjustment of the tools 1 in known manner by means of wedge surfaces, etc. This is preferably accomplished by providing inclined, parallel teeth on the pressure rod 4 which mesh with corresponding teeth on the tool carrier as illustrated on the drawings. The tool 1 is thus displaced radially by the axial movement of the teeth provided on the rod 4. At its free end the pressure rod 4 carries the pistion 5 which in the cylinder 6 can be acted upon through the supply pipes 7 and 8 on both sides by a pressure medium. The pipings 7, 8 are connected to the control casing 9 in the guide box 10 (Fig. 2) of which a control slide valve is arranged preferably comprising a series of pistons disposed one behind the other. The control slide valve is connected with a feeler roll 11 past which the template 12 to be checked is moved, which for this purpose is connected by a rod 13 with the table 14 of the mill. The casing 9 is preferably connected by a rack 15, toothed wheels 16, 17 and an additional rack 32 with the pressure rod 4 in such manner that the position of the casing 9 exactly corresponds to that of the pressure rod 4.

The movement of the template 12 conforms completely with that of the work table 14. In general, and as exemplified in the drawings, the boring spindle 2 and the work-piece are securely attached to the working table 14, which in turn performs the thrust motion. Naturally it may also be possible to permit the spindle block to perform such thrust motion instead of the work table. It is entirely immaterial for the template which one of the two methods is used. The template presents clearly the profile of the boring to be produced by the tool 1. There is accordingly no need for the template to rotate but that it is instead to be displaced parallel to the boring spindle axis. It will therefore be clearly understood that it is entirely immaterial whether the work piece performs a thrust motion or a rotating motion, or that the spindle on the other hand only rotates or both rotate and also performs a thrust motion, or that it stands perfectly still. The main point is that a radial displacement of the tool 1 takes place corresponding to the form of the template during the boring between the tool and the work piece.

To insure accurate adjustment of the members 18, 24, 27, 38 of the piston series (Fig. 2) between the individual pistons an adjusting device 40 (Fig. 2) is disposed consisting of a spindle both ends of which have a thread 45 and which can be secured by means of the check nuts 46. Connection of the adjusting spindle 45 with the pistons 18 and 24 or 27 and 38 is effected by means of the balls 47, 48 held in the pistons by the sockets 49, 50 to provide for better independent guiding of the pistons. The sockets 49, 50 may be secured by the check nuts 51, 52. To prevent the ball 47 from turning loose from the member 45 the ball is further secured by a pin 53. Sealing of the pistons against the passage of leaking oil is insured by the provision of corresponding annular spaces 54, 55 which are in communication with the supply piping 23 for the pressure medium by the bores 56, 57, 58.

To regulate the application pressure of the piston series and of the roll 11 relative to the copying template 12 the pressure oil chamber 16 covered with a lid is in communication with an overpressure valve 59 (Fig. 3) by means of which a certain constant pressure can be adjusted in the chamber 16. To insure accurate transmission of the motion of the feeler roll 11 to the control piston, the roll is arranged in a carriage 65 (Fig. 2) having ball or roller guides 67, 68 and contacting with its flat front face 69 with the curved front face 70 of the control piston 18.

The casing 9 of the control piston possesses at its lower end cylinder spaces 60, 61 (Fig. 4) disposed oppositely to one another in diagonal direction and having pistons 62, 63 guided therein. By means of these pistons the casing 9, relative to the machine frame, is pressed up, as the chambers 60, 61 are brought into communication with the supply piping 21 for the pressure medium by the bores 71, 72 and 64. In this manner any play existing between the machine parts to be controlled is continually eliminated. By means of sliding or roller guides, suitably arranged at the proper points, and not shown, the casing 9 is guided on the machine frame. The piston series or the roll 11 or the pressure member 65 interposed between the former and the latter has a shoulder 42 capable of seating against an adjustable stop 43, preferably having the form of a micrometer screw 44 secured on the machine frame, on the casing 9, so that the maximum stroke of the control device can be limited thereby. This limitation is of particular importance in case of relatively large internal bores and permits flat working at the beginning, which is then gradually deepened, while the deepest points of the template are not covered as yet, but, whilst the control piston is held at the stop 43 and the template idles, a cylindrical surface having a smaller diameter than the one to be attained is produced.

It is further possible, within the scope of the invention, to impart to the member to be checked as well as to the machine part or work to be influenced a plurality of motions carried out at a certain angle to one another. In this way any motions may be transmitted from one machine part to another.

The device according to the invention functions as follows:

Owing to the motion of the roll 11 past the template 12, the control slide, or the series of pistons arranged in the casing 9, are lifted to an extent corresponding to the deepening of the template by the action of liquid pressure exerted in the chamber 16 upon the lower piston end 17. The result is a displacement of the controlling edge of the control piston 18 relative to the opening edge 19 of the opening 20, so that the pressure oil, which through the portion 21, the bore 22 and the annular channel 23 has entered the cylinder space 25 containing the connection of the two pistons 18 and 24, passes from the space 25 through the opening 20 in the conduit 26 indicated by broken lines and communicating with the piping 8 for the pressure medium. Simultaneously, by the lifting of the piston 27 communication of the piping 7 with the annular space 29 is effected by the bore 28, the space 29 being in communication again with the outflow pipe 31 through the return flow throttle 30. Therefore, from the left piston side of the cylin-

der 6 through the piping 7 pressure oil that has flown to the right-hand cylinder side through the piping 8 and is displaced by the piston 5 flows back, the return throttle 30 taking care that the flow of the displaced oil takes place under constant counter-pressure. Displacement of the piston 5 and thus of the pressure rod 4 and of the tools 1 continues until the rack 15, the toothed wheels 16, 17 and the rack 32 firmly connected with the casing 9 have effected resetting of the casing 9 and of the control edges 19 and 33 connected therewith to such an extent that further admittance of pressure medium through the bore 26 and the piping 8 to the right-hand side of the piston 5 is interrupted. At a motion of the roll 11 and thus of the piston series in opposite direction the process is similar. Supply of oil is then effected past the controlling edge of the piston 24 and the controlling edge 34 of the casing 9 through the bore 35 to the piping 7. The bore 28 communicating with the bore 35 is closed in the meantime. Owing to the downward motion of the piston series, the controlling edge of the piston 38 and the control edge 39 of the casing 9 have, however, brought the piping 8 in communication with the return throttle 30 by means of the annular space 29, so that from the right hand side of the piston 5 pressure oil flows off through the piping 8. Even during a motion in this direction, resetting of the casing 9, by means of the motion of the pressure rod 4, causes displacement of the latter only to the extent corresponding to the form of the template 12 at this point. The bore produced in this manner by the tools has therefore exactly the profile prescribed by the template 12. Inaccuracies can be eliminated by accurate regulation of the distance of the control edges of the pistons 18 and 24 by means of the bolting 40 flexibly connecting the two pistons.

To make possible gradual removal of the material treated the template 12, by means of the micrometer screw 41, is advanced towards the feeler to the required extent. It is further advisable to prevent the boring tool from cutting beyond a certain depth by limiting the upward stroke of the piston series by a fixed stop 43 acting on a shoulder 42 thereof and having preferably the form of a micrometer screw 44.

Instead of the racks 15 and 32 steel bands may be employed if desired which wind up on drums corresponding to the toothed wheels 16, 17. The device according to the invention can serve also for controlling a larger number of machine parts by securing for instance to the piston rod of the piston 5 a pressure plate 75 of sufficient size, which is then engaged by the various pressure rods of multi-spindle boring mills.

I claim:

1. A profiling attachment particularly for fine boring mills comprising a pressure rod provided in a boring rod of the mill, a double-acting auxiliary power piston to which the pressure rod is connected and which is capable of being acted upon by a pressure medium, a control slide valve adapted to regulate the flow of the pressure medium to and from the piston, a template adapted to be moved past the control slide valve, a control casing in which the slide valve is provided, means for transmitting the movement of the auxiliary power piston to the control casing to set back the latter, means for moving the template past the control slide valve relative to the movement of a work piece and a tool, and guide means for supporting the control casing on the machine frame of the mill.

2. A profiling attachment according to claim 1, in which one piston and a cylinder are provided in the control casing to constantly eliminate any play between the machine parts to be controlled.

3. A profiling attachment according to claim 1, in which a pressure chamber and a regulatable overpressure valve are provided to subject the control slide valve to a constant adjustable tension.

4. A profiling attachment according to claim 1, in which a pressure plate is provided for the simultaneous control of a machine part, said pressure plate being engaged by the machine part to be controlled.

5. A profiling attachment according to Claim 1, in which a pressure plate, toothed wheels and a rack are provided which form the operative mechanical connection between the casing and the machine part to be controlled.

6. A profiling attachment according to claim 1, in which a regulatable throttle valve is provided arranged in a return piping of the pressure medium.

7. A profiling attachment according to claim 1, in which a micrometer screw is provided to render the template adjustable in a direction disposed vertically to the direction of motion thereof.

8. A profiling attachment according to claim 1, in which between the control casing and the feeler roll or the piston an adjustable stop is provided for regulating the maximum relative motion between the piston and the casing.

9. A profiling attachment according to claim 1, in which an intermediate member, rows of balls and prisms are provided so that the motion of a feeler roll to the piston is transmitted by an intermediate member which is guided between the rows of balls disposed in the prisms and against the preferably plane front face of which the curved front face of the piston is seated.

10. A profiling attachment for boring machines, comprising a double acting auxiliary power piston capable of being acted upon by a pressure medium, a control valve adapted to regulate the flow of pressure medium to and from said power piston, a template adapted to be moved past the control valve, a control casing in which said control valve is guided and containing a pressure chamber, an adjustable over-pressure valve in said control casing for subjecting the control valve to a constant regulatable tension as regards the template, and means for displacing the tool through the movement of the auxiliary power piston.

11. A hydraulic profiling attachment for boring machines comprising a double acting auxiliary power piston capable of being acted upon by a hydraulic pressure medium, a control casing, a control valve guided therein and being adapted to regulate the flow of said pressure medium, said control valve being composed of a plurality of pistons forming a chain, a template adapted to be moved past the control valve, said casing being provided with a pressure chamber and an adjustable over pressure valve in said casing for subjecting the control valve to tension as regards the template, and means for displacing the tool through the movement of the auxiliary power piston.

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