Sept. 29, 1953 E. S. SAXTON 2,653,518

MEANS FOR ADAPTING MACHINE TOOLS FOR PROFILING PURPOSES

Filed March 22, 1951 2 Sheets-Sheet 1

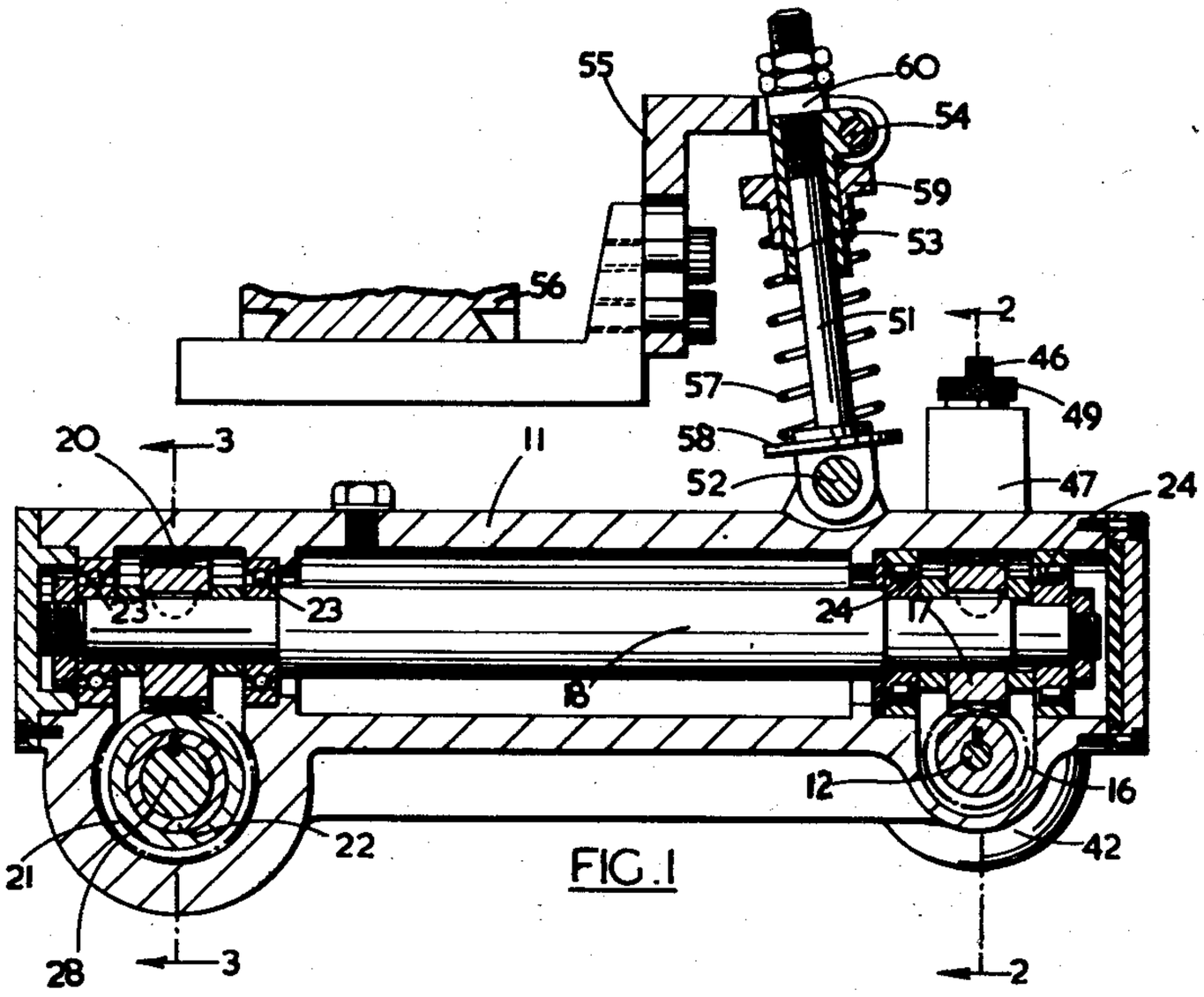

FIG. 1

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FIG. 2

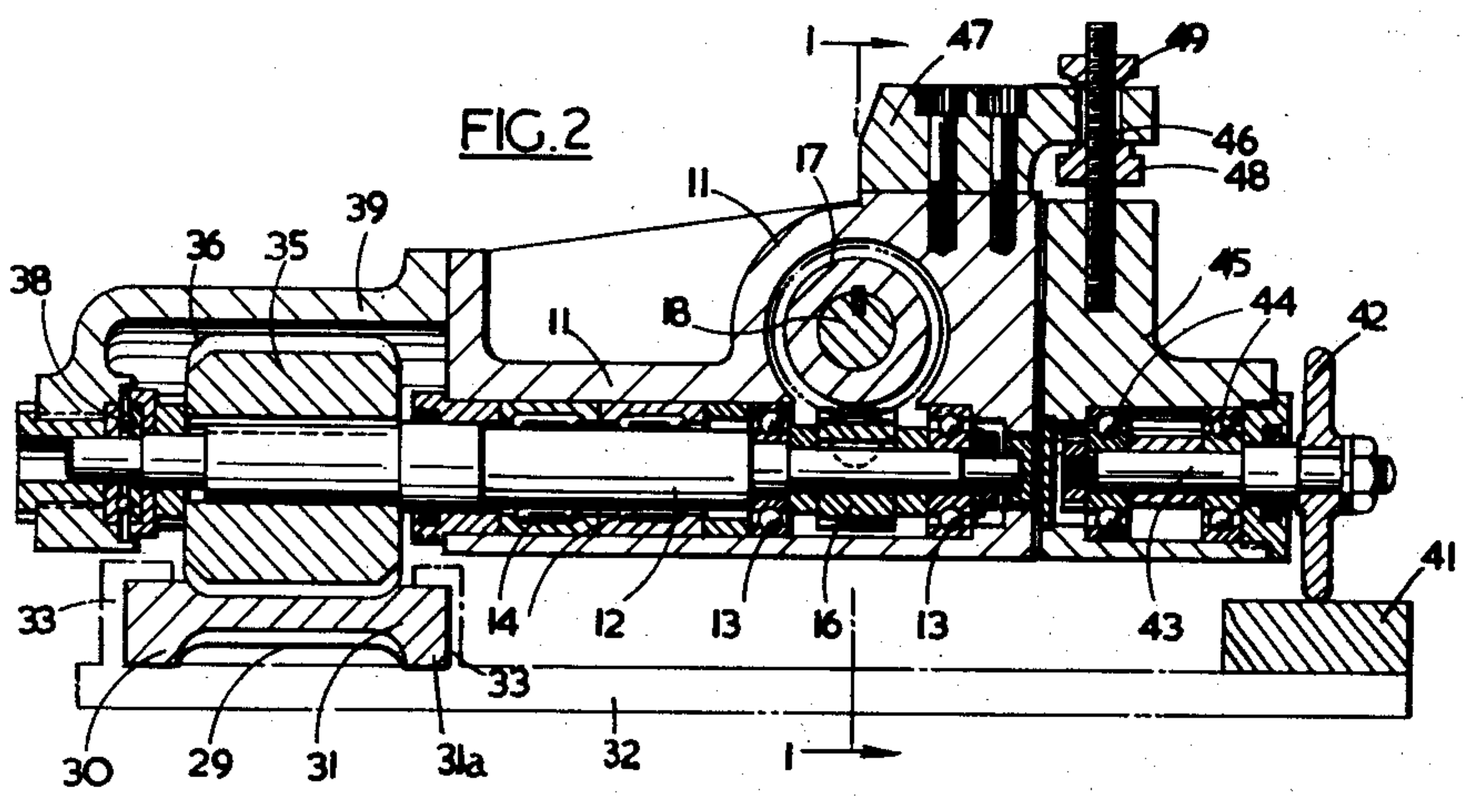
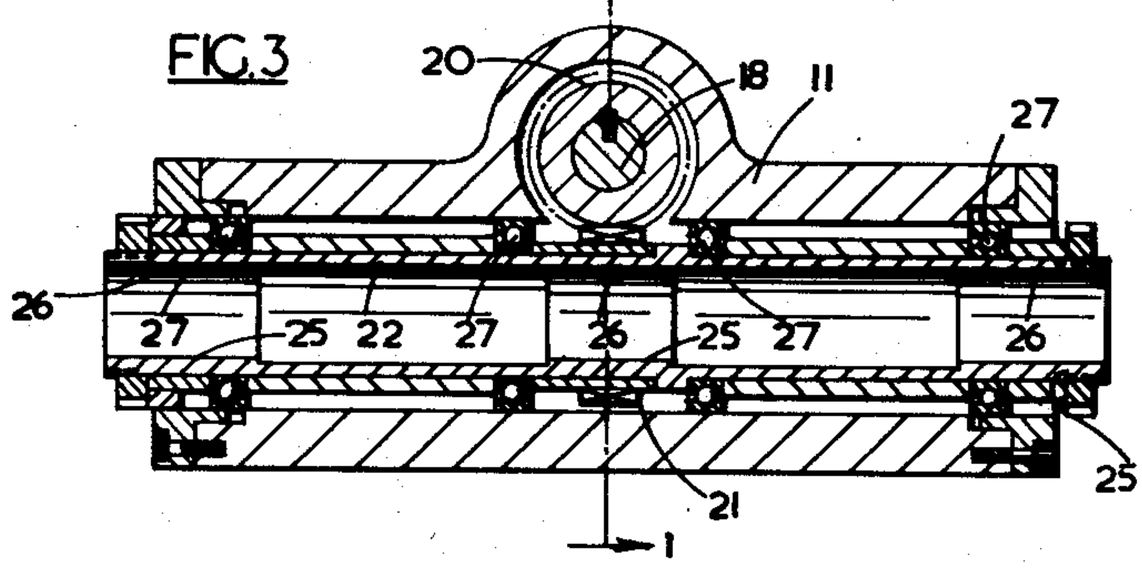


FIG. 3



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MEANS FOR ADAPTING MACHINE TOOLS FOR PROFILING PURPOSES

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2 Claims. (Cl. 90—13.1)

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The present invention relates to a machine-tool of the kind having a rotating shaft and a slide movable relatively to the shaft for a surface of a work-piece on the slide to be machined.

The invention is particularly applicable to a horizontal milling machine, in which the rotating shaft is commonly known as the arbor.

The main object of the invention is to enable the machine-tool to be converted into a copying or profiling machine.

The invention involves the combination with a machine-tool as aforesaid, of an attachment or fixture the main portion of which is movable about the axis of a sleeve adapted to be carried by the said rotating shaft in driving engagement therewith, the main portion of the fixture carrying a spindle parallel to the sleeve and connected to be driven therefrom, and means biassing the main portion of the fixture to press a cutter carried by the spindle against a work-piece, and to press a follower carried by the said portion against a master profile member, the work-piece and the profile member being appropriately placed on the slide so as to carry the work-piece past the cutter while the profile member is being moved past the follower.

In the accompanying drawings:

Figure 1 is a sectional elevation of a fixture according to the invention, the section being taken on the line 1—1 of Figure 2 or of Figure 3; and the figure also shows part of the overhead arm of a horizontal milling machine supporting a bracket against which reacts a spring for biassing the main portion of the fixture;

Figure 2 is a cross-section taken on the line 2—2 of Figure 1, but omitting the overhead arm and the biassing spring, the figure also showing, by chain lines, part of the slidable table of the machine, supporting a work-piece to be machined and a standard or master profile member; and

Figure 3 is a cross-section taken on the line 3—3 of Figure 1 but omitting the rotating arbor of the machine.

Referring to the drawings, the fixture comprises a frame 11 in which a spindle 12 is journalled through a pair of ball bearings 13 and a pair of needle bearings 14. Fast on the spindle, between the two ball bearings, is a skew gear 16 driven from a skew gear 17 fast on a transverse shaft 18. The other end of the transverse shaft carries a skew gear 20 driven from a skew gear 21 fast with a sleeve 22. The transverse shaft 18 is journalled in the frame 11 by means

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of a pair of ball bearings 23 associated with the skew gear 20, and by means of a pair of roller bearings 24 associated with the skew gear 17. The sleeve 22 is shown as being a hollow one having portions 25 of its bore reduced in cross-section, these thickened portions each having in them a key-way 26 by means of which a drive can be established with the rotating arbor 28 of the machine in any usual manner. The sleeve is journalled in the frame, and axially located with respect thereto, through ball bearings 27.

The work-piece 29 in Figure 2 is shown as being a blade for a compressor or turbine of a gas turbine engine, the profile of the blade being one which does not change its form from the root 30 to the tip 31. The blade is detachably supported on the slidable table 32 of the milling machine in any usual manner, as by means indicated at 33. The tip block 31*a* is, of course, removed on completion of machining.

In such a case, and if the blade is not too long, the cutter 35 for machining the blade may be of a length not less than the length of the blade so that the whole of one face of the blade can be machined during a single traverse (towards or away from one in Figure 2, i. e., in a direction at right-angles to the plane of the figure) of the table, and the edge 36 of the cutter is shown as being shaped for machining the face of the root 30 where the blade joins it.

The cutter is fast on an overhanging end of the spindle 12, and a thrust bearing 38 is provided near the extremity of the overhanging end, the bearing reacting against a cover 39 for the cutter which is secured in any convenient manner to the frame 11.

The table 32 also carries a master profile member 41 which may be secured in position in any usual manner, and coacting therewith is a follower 42. Instead of being mounted on the other end of the spindle 12, the follower 42 is mounted upon the end of a separate spindle 43 which is generally coaxial with the spindle 12 and is journalled through ball bearings 44 in a support 45 adjustably attached to the frame 11. The drawings show the support 45 as carrying a stud 46 extending through a clearance hole in a bracket 47 fast with the frame 11, the stud being located relatively to the bracket by means of adjustable nuts 48, 49. In this way the spindle 43 can be very accurately set up, and the follower can, of course, be easily replaced when necessary.

It will be evident that, when machining a com-

pressor or turbine blade which is sufficiently long to render it impracticable to use as a cutter of at least the length of the blade, two or more traverses of the table, with the necessary intermediate adjustments lengthwise of the blade, can be made in the usual manner. In the case in which the form of the profile of the blade does change from the root to the tip, use should be made of a cutter which is axially short, and, after each traverse of the table, the necessary adjustment will be made until the whole face of the blade has been machined.

One method of biassing the frame of the fixture in the engaging direction is shown in Figure 1, in which use is made of a stem **51** hinged at **52** to the fixture and slidingly guided at its other end in a bush **53**. The bush is pivoted at **54** upon a bracket **55** carried by the overhead arm, indicated at **56**. The biassing spring **57** reacts between an abutment **58** at one end of the stem and a collar **59** at the other. Figure 1 shows the biassing spring **57** when fully extended, the movement of the fixture away from the overhead arm being limited by an adjustable abutment **60** on the free end of the stem.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. Means for converting into a copying machine a machine-tool such as has a rotating shaft and a slide movable relatively to the shaft for a surface of a workpiece on the slide to be machined, including a sleeve adapted to be carried by the rotating shaft in driving engagement therewith, a frame journaled on said sleeve, a spindle rotatably carried by said frame parallel to and remotely from said sleeve, means providing a driving connection between said sleeve and said spindle, a cutter drivingly carried by said spindle, a follower spaced beyond one end of said spindle, a support for said follower carried by said frame, guide means interconnecting said support and said frame for relative movement in a direction at right angles to the longitudinal axis of said spindle whereby to enable said follower and said cutter to be moved relatively laterally into and out of coaxiality, means setting said cutter and said follower in a selected position of the lateral adjustment, and means biassing said frame to press said cutter and follower respectively against a work-piece and master profile member when the latter are appropriately placed on the slide so that the work-piece will be carried past said cutter while the profile member is being moved past said follower.

2. Means for converting into a copying machine a machine-tool such as has a rotating shaft and a slide movable relatively to the shaft for a surface of a work-piece on the slide to be machined, including a sleeve adapted to be carried by the rotating shaft in driving engagement therewith, a frame journalled on said sleeve, a spindle rotatably carried by said frame parallel to and remotely from said sleeve, a transverse shaft journalled in said frame and connected at its ends with said sleeve and said spindle respectively through skew gears, a cutter drivingly carried by said spindle, a support adjustably connected with said frame, a stub shaft journalled in said support and spaced beyond one end of said spindle, a follower carried by said stub shaft, the adjustable connection between said support and said frame comprising guide means whereby said support can be moved relatively to said frame at right-angles to the longitudinal axis of said spindle for moving said stub shaft into and out of coaxiality with said spindle, screw actuated means interconnecting said support and said frame for moving them relatively along said guide means for selectively setting said spindle and stub shaft with their axes in a desired relationship, and means biassing said frame to press said cutter and follower respectively against a work-piece and master profile member when the latter are appropriately placed on the slide so that the work-piece will be carried past said cutter while the profile member is being moved past said follower.

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