Oct. 15, 1946. A. J. McDONALD 2,409,578

BORING MACHINE

Filed Dec. 20, 1944 2 Sheets-Sheet 1

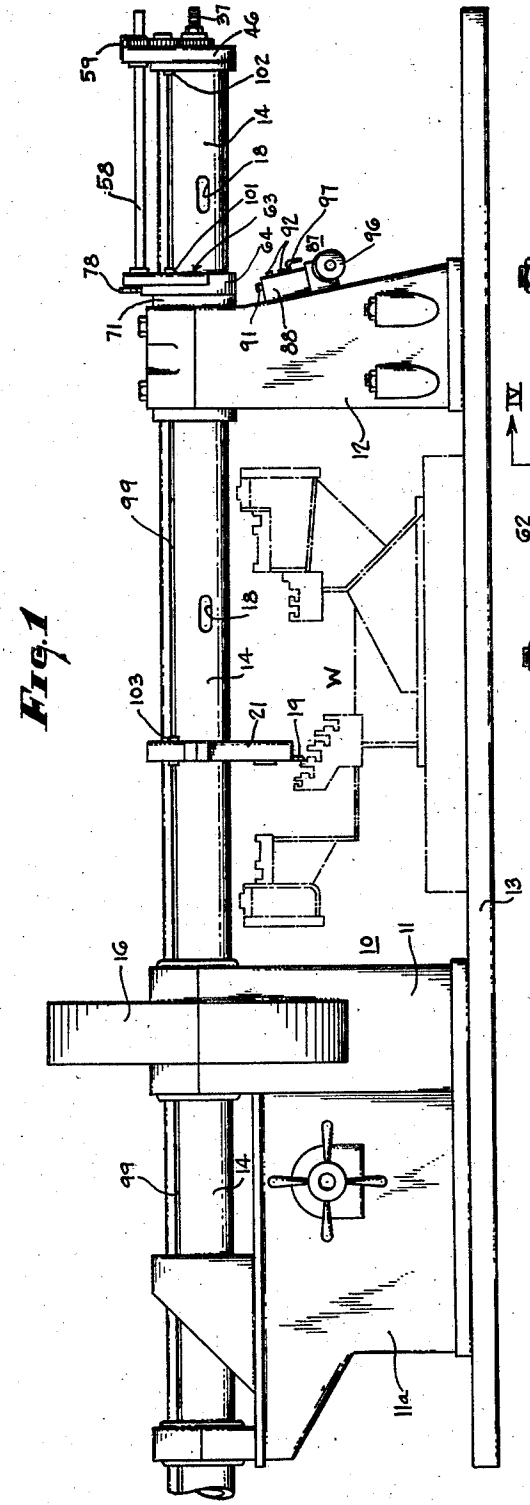

Fig. 1

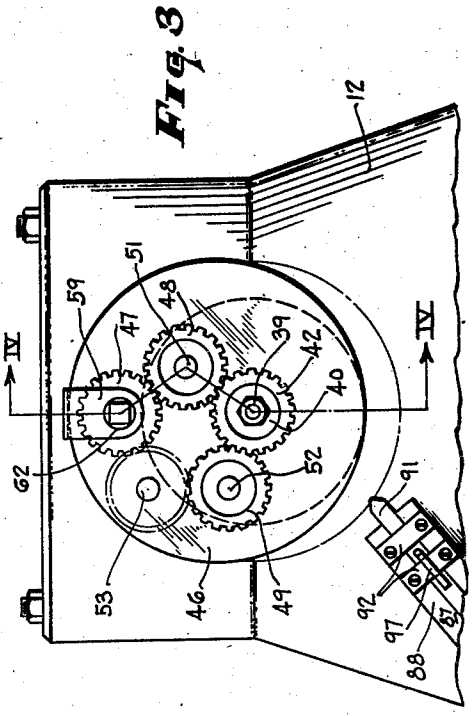

Fig. 3

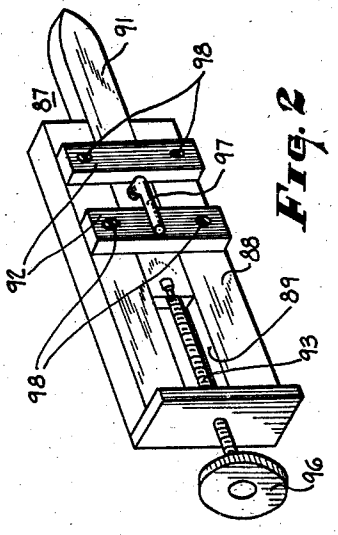

Fig. 2

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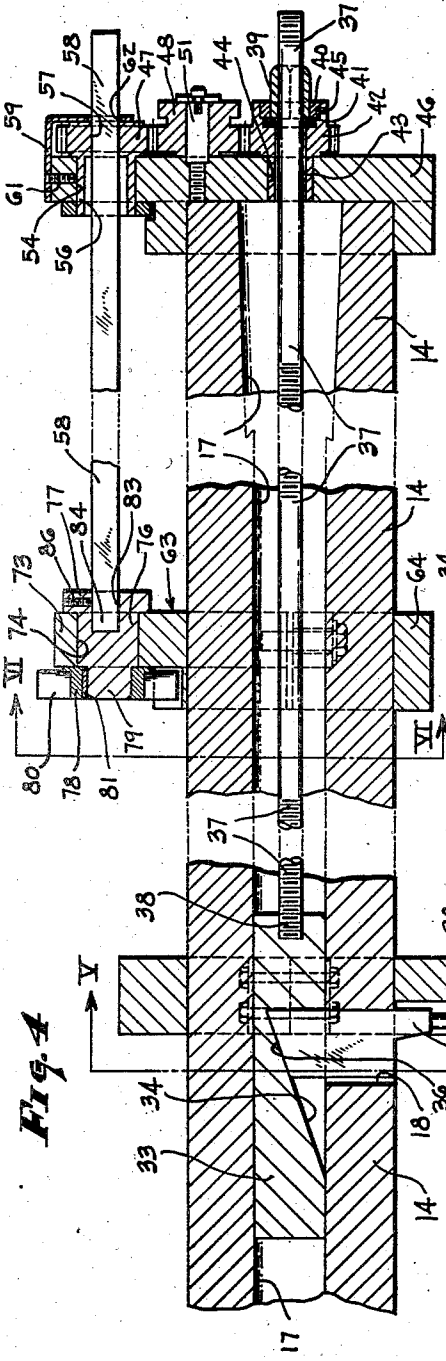

Fig. 4

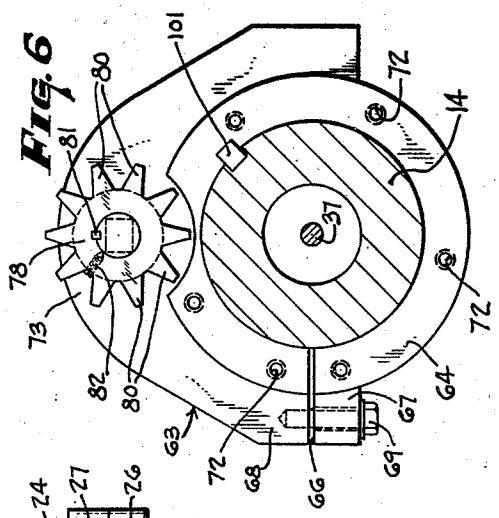

Fig. 6

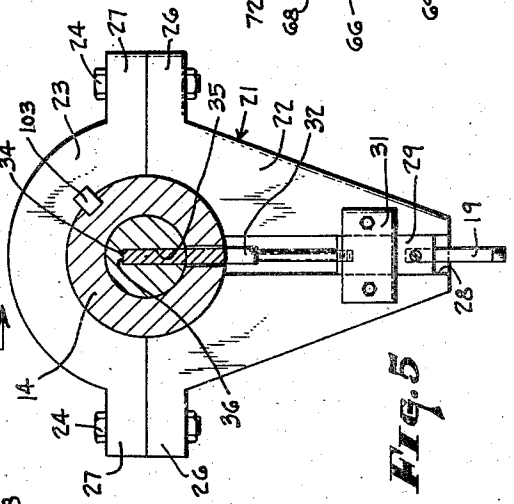

Fig. 5

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BORING MACHINE

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3 Claims. (Cl. 90—24)

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This invention relates to machine tools, more particularly to boring machines of the horizontal hollow-bar type, and has for an object to provide improved feeding means therefor.

In the horizontal hollow-bar type of boring machines now in general use, and in which a cutter head mounted on the hollow bar carries a work-engaging tool adapted to be fed radially of the bar through axial movement of a pull-rod-actuated wedge, the pull rod has a threaded end extending beyond an end of the hollow bar and threadedly engaged in an internally-threaded gear nut. This gear nut is the last, or driven, gear of a train of gears mounted on an end plate, carried by the end of the hollow bar, while the first, or driving, gear of the train includes a ratchet wheel, or star, whose teeth, or points, engage a kicker once during each revolution of the hollow bar to drive the gear train and rotate the gear nut to move the pull rod axially.

Inasmuch as the end of the hollow bar, on which the star and its train of gears are mounted, usually projects several feet beyond the spaced pair of pedestals which support the bar, it has been customary to provide a third pedestal, adapted to carry the kicker and to be placed, by the operator, in a position where the kicker will engage the points of the star as the bar rotates. Inasmuch as the bar is usually some four and a half or five feet above the floor, the third pedestal has to be of a corresponding height, and consequently of considerable width to prevent its being upset. As a result, such pedestals usually weigh several hundred pounds, and such weight is further desirable to prevent accidental movement of the pedestal, which could easily occur if the pedestal were not very heavy, particularly as such machines are usually arranged at right angles to an aisle in the machine shop, with the end of the bar carrying the star adjacent the aisle and sometimes even projecting into the latter which means that the third pedestal also must be in or near the aisle, where it is subject to knocks by passing trucks, cranes, etc. Obviously, such accidental movement of the pedestal would interrupt radial feed of the tool if the kicker were moved out of the path of the star, and would cause too rapid feed, or even breakage, if the kicker were moved so as to engage too many of the star teeth at each contact therewith.

Another serious disadvantage of the use of the third pedestal to carry the kicker is that, when the hollow bar is moved axially to align the tool with a different part of the work to be machined, the third pedestal and its kicker must also be

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moved to maintain cooperation of the kicker with the star. In many types of boring, for example, in cutting the radial grooves in turbine cylinders or casings for reception of turbine blade roots, the bar has to be moved axially to several dozen different positions, each requiring a new position of the heavy pedestal carrying the kicker.

Therefore, another object of the present invention is to provide a fixed support for the kicker of a horizontal hollow-bar boring machine feed mechanism.

A further object of the invention is to provide, in a boring machine of the horizontal hollow-bar type, a tool-feeding mechanism having a fixed position for the kicker and star, together with a flexible drive from the star to the work-engaging tool.

Another object of the invention is to provide, in a boring machine of the horizontal hollow-bar type, a star clamp ring adapted to be secured to the horizontal bar adjacent one of the bar-supporting pedestals, together with a star rotatably supported by the clamp ring, and a shaft of non-circular cross section rotatable with the star and having a slidable driving connection with the conventional feed mechanism of such boring machines.

Yet another object of the invention is to provide a fixed support for the kicker of a boring machine radial feed mechanism.

A further object of the invention is to provide, in the radial feed mechanism of a boring machine, a star and kicker therefor, both having a fixed position axially of the machine, together with means for providing continuous feeding drive from the star to the radially-fed tool, regardless of the axial position of the boring bar relative to the star and its kicker.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in accordance with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a side elevational view of a horizontal hollow-bar type of boring machine embodying the principles of the present invention;

Fig. 2 is an enlarged perspective view of the kicker mechanism;

Fig. 3 is an enlarged, fragmentary elevational view of the right-hand end of the structure illustrated in Fig. 1;

Fig. 4 is an enlarged, fragmentary sectional view of the work-engaging tool and its feeding mechanism, taken along the line IV—IV of Fig.

3, looking in the direction indicated by the arrows;

Fig. 5 is a sectional view, taken along the line V—V of Fig. 4, looking in the direction indicated by the arrows; and,

Fig. 6 is a sectional view, taken along the line VI—VI of Fig. 4, looking in the direction indicated by the arrows.

Referring now to the drawings more in detail, and particularly to Fig. 1 thereof, the reference character 10 indicates, in its entirety, a boring machine of the horizontal, hollow-bar type and comprising a pair of spaced pedestals 11 and 12, bolted, or otherwise secured, to the usual bedplate 13. The pedestals carry bearings (not shown), in which is journaled the horizontally-disposed hollow bar 14. The pedestal 11, and its extension 11*a*, house the gearing and control mechanism through which the bar 14 is rotated by a motor (not shown), the main gear being within the gear casing 16.

The bar 14 is provided with an axial bore 17, Fig. 4, extending entirely therethrough, and a plurality of axially-spaced radial openings 18 provide for radial feed of the work-engaging tool 19, in the manner hereinafter described. The cutter head 21, formed in two parts 22 and 23, clamped on the bar 14 by bolts 24 in the mating flanges 26 and 27, is provided with a radial groove 28, in which a tool carrier 29 is slidably retained by the plate 31. A feed push pin 32 extends radially through a selected one of the openings 18 of the bar and transmits radial movement to the tool carrier 29 from an axially-movable cam member or wedge 33, disposed in the bore 17 of the bar 14. The wedge 33 has an inclined surface 34 at the bottom of a groove 35, mating with a correspondingly-inclined surface 36 on the inner end of the feed push pin 32, which inner end is slidably received in the groove 35 of the wedge 33.

A pull rod 37 is threadedly connected to the wedge member 33, at 38, and has its other end threadedly received in the pull rod nut 39, beyond the righthand end of the hollow bar 14, as viewed in Figs. 1 and 4. The nut 39 is non-rotatably received in a mating recess 41, in a driven gear 42, whose hollow extension shaft 43 is rotatably mounted in a bearing opening 44 in the end plate 46.

A collar 40 surrounds a portion of the pull rod nut 39 and retains it in the recess 41, the collar 40 being held by the set screws 45. The end plate 46 is fixedly secured on the end of the hollow bar 14 and carries a driving gear 47, and a pair of intermediate or idler gears 48 and 49, mounted on stub shafts 51 and 52, respectively. A third stub shaft 53 is provided, and the idler gear 48 may be removed from the stub shaft 51 and placed on the shaft 53 to obtain rotation of the driven gear 42 in the same direction, regardless of the direction of rotation of the bar 14, as a result of establishing a four-gear train in place of the three-gear train illustrated in Fig. 3.

The end plate 46 is provided with a bearing opening 54 rotatably receiving the hollow extension shaft 56 of the driving gear 47, this gear having an axial opening 57 therethrough of square cross section for reception of the rod or shaft 58 of corresponding cross section. Obviously, the opening 57 and shaft 58 may be of any non-circular section.

Inasmuch as the shaft 58 and the axial opening 57 of the gear 47, in which the shaft is received, are of the same shape and have a sliding fit, rotation of the shaft will effect corresponding rotation of the driving gear 47, and hence of the entire gear train, including the pull rod nut 39.

Since the bar 14 and its end plate 46 and driving gear 47 are adapted to slide longitudinally relative to the shaft 58, the gear 47 is retained in position against the end plate by suitable means, such as the angle piece 59, secured to the end plate by the screws 61, and overlapping the outer face of the gear 47, with the shaft 58 extending through the opening 62 in the angle piece.

A star clamp ring 63, in the form of a split collar 64, having a joint 66 provided by the mating flanges 67 and 68, which are adapted to be drawn together by bolts 69, is clamped on the hollow bar 14 adjacent the outer bushing 71 of the pedestal 12. The star clamp ring 63 may, in addition to or in place of being clamped, be bolted to the bushing 71 by bolts extending through the openings 72 in the clamp ring (Fig. 6).

The upper flange 68 of the star clamp ring extends slightly more than 180 degrees about the ring and includes a portion 73 of maximum radial extent, in which is provided a bearing opening 74, rotatably supporting a stub shaft 76. The stub shaft is retained in position in the bearing opening 74 by the flange 77 at one side and by by the star or ratchet wheel 78, on the shaft extension 79, at the other side. The star 78 is keyed to the shaft extension 79, as at 81, and is retained thereon by the set screw 82.

The flange 77 is provided with an axial opening 83, of square cross section, to receive the terminal portion 84 of the square shaft 58, the terminal portion being retained therein by the set screw 86.

A kicker indicated in its entirety by the reference 87, Figs. 2 and 3, is mounted on the outer face of the pedestal 12, and comprises a block 88 having a groove 89 extending lengthwise thereof. A kicker tongue 91 is slidably retained in the groove 89 by the guide straps 92, and may be adjusted therealong by the screw 93, threadedly mounted in the end strip 94, with its inner end rotatably secured to the rear end of the tongue and its outer end provided with a finger piece 96. The tongue may be further secured in any selected position of adjustment by tightening of the clamping stud 97, which is threadedly mounted in the tongue, so that the point of the stud engages the bottom of the groove 89. The screws 98, which retain the guide straps 92 on the block 88, may be of sufficient length to also secure the complete kicker assembly 87 to the pedestal 12.

The hollow bar 14 is provided with an external keyway 99 extending from end to end thereof and receiving keys 101, 102 and 103, cooperating with radially-aligned keyways in the star clamp ring 63, the end plate 46, and the cutter head 21, respectively. The keyways in the star clamp ring and in the end plate are so disposed that the bearing openings 74 of the former and 54 of the latter, are axially aligned, with the result that the shaft 58 is parallel to the bar 14 at all times.

In operation, the apparatus is arranged as previously described and as illustrated in the drawings, particularly Fig. 1, wherein the cutter head 21 is shown positioned with its tool 19 engaging a surface of the work which requires a radial cut. The dot-dash lines of Fig. 1 indicate the longitudinal cross section of a turbine lower cas-

ing, comprising the work W. The driving mechanism, housed within the pedestal 11 and its extension 11*a*, rotates the hollow bar 14, together with the cutter head 19, the bushing 71, the star clamp ring 63, the end plate 46 and its train of gears 47, 48 and 42. During each complete revolution of the bar 14, one of the points 80 of the star 78 is engaged by the tongue 91 of the kicker 87. Where a ten point star is used, as herein illustrated, the squared shaft 58 will be rotated one-tenth of a complete turn, and such rotation of the shaft 58 actuates the gear train to correspondingly rotate the pull rod nut 39. As this nut turns, the pull rod 37, which is non-rotatable relative to the bar 14 and end plate 46, is moved axially of the bar 14, imparting the same axial movement to the wedge member 33, thereby moving the feed push pin 32 and its associated tool carrier 29 and tool 19, radially.

When machining of one radial groove of the work W has been completed, it is only necessary to loosen the bushing 71 and the star clamp ring 63 on the bar 14 and to move the latter axially, to bring the tool 19 into position at the new groove of the work, after which the bushing 71 and star clamp ring are again tightened on the bar 14, and the machining operation repeated. When the bar 14 is thus moved to bring the tool to its new position, the driving gear 47 merely slides along the squared shaft 58, without any change in the alignment of the star 78 and the kicker 87. Thus the previously necessary moving of a third pedestal, carrying the kicker, to align the latter with the new position of the star, where the latter was mounted on the end plate and therefore moved with the star, is entirely eliminated by the present invention.

While this invention has been illustrated in but one form, it will be apparent to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof.

What is claimed is:

1. Apparatus of the character described comprising a pair of spaced pedestals, a hollow bar rotatably and slidably supported in horizontal position by said pedestals, a cutter head secured on said bar and including a radially-movable cutting tool, a wedge axially movable in the bore of the hollow bar and adapted when so moved to move the cutting tool radially, an end plate secured to one terminal portion of the bar, a rod secured at one end to the wedge and having its other end externally threaded and extending through and beyond said end plate, a train of meshing gears mounted on said end plate and including a driving gear having an axial bore and a driven gear having a threaded bore threadedly receiving the threaded end of the rod, a star-supporting ring secured on the bar adjacent the pedestal nearest the end plate and having a bore therein axially aligned with the bore of the driving gear, a shaft mounted in said axially-aligned bores, a star fixedly secured on said shaft, and a kicker mounted on the last-mentioned pedestal for engaging and rotating the star responsive to rotation of the bar, the shaft being rotatably and non-slidably mounted in the bore of the star-supporting ring and being slidably and non-rotatably mounted in the bore of the driving gear, whereby rotation of the star upon contact thereof with the kicker will actuate the wedge-moving rod regardless of axial adjustments of the hollow bar relative to the pedestal-supported kicker.

2. Apparatus of the character described comprising a pair of spaced pedestals, bearings carried by said pedestals, a hollow bar rotatably journaled in said bearings in horizontal position and axially adjustable relative thereto, a cutter head secured on said bar and including a radially-movable cutting tool, a wedge axially movable in the bore of the hollow bar and adapted when so moved to move the cutting tool radially, a pull rod within the bore of the bar and secured at one end to the wedge with its other end threaded and projecting beyond an end of the bar, a train of gears carried by said bar adjacent said end thereof and including a driving gear having an axial bore and a driven gear having a threaded bore threadedly receiving the threaded projecting end of the pull rod, a star-supporting ring secured on the bar in predetermined position axially thereof relative to the pedestals and having a bore therein axially aligned with the bore of the driving gear, a shaft mounted in said axially-aligned bores, a star secured on said shaft, and a kicker supported by one of the pedestals in position to engage and rotate said star responsive to rotation of the bar, said shaft being rotatably and non-slidably mounted in the bore of the star-supporting ring and being slidably and non-rotatably mounted in the bore of the driving gear, whereby rotation of the star upon contact with the kicker will actuate the wedge-moving pull rod regardless of axial adjustments of the hollow bar relative to the pedestal-supported kicker.

3. In mechanism for feeding radially the cutter of a horizontal hollow-bar type of boring machine, wherein a train of gears effects axial movement of a pull-rod-actuated cutter-feeding wedge; a stationary support; a kicker carried by said stationary support; a movable support; a shaft carried by said movable support and adapted to rotate relative thereto; a star carried by said shaft and adapted to rotate the latter relative to the movable support; means for imparting motion to the movable support, the kicker being so positioned with respect to the movable support and the shaft and star carried thereby that said star is contacted and partially rotated by the kicker during each cycle of movement of said movable support; and an axially-slidable driving connection between the shaft and the train of gears, whereby the partial rotation of the star due to contact thereof with the kicker is transmitted through the shaft to the gear train, said sliding connection providing for transmission of rotation from the star to the gear train regardless of the axial spacing of said star and gear train.

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