Dec. 5, 1939. H. L. BLOOD 2,182,276

APPARATUS FOR HONING

Filed Nov. 5, 1936 2 Sheets-Sheet 1

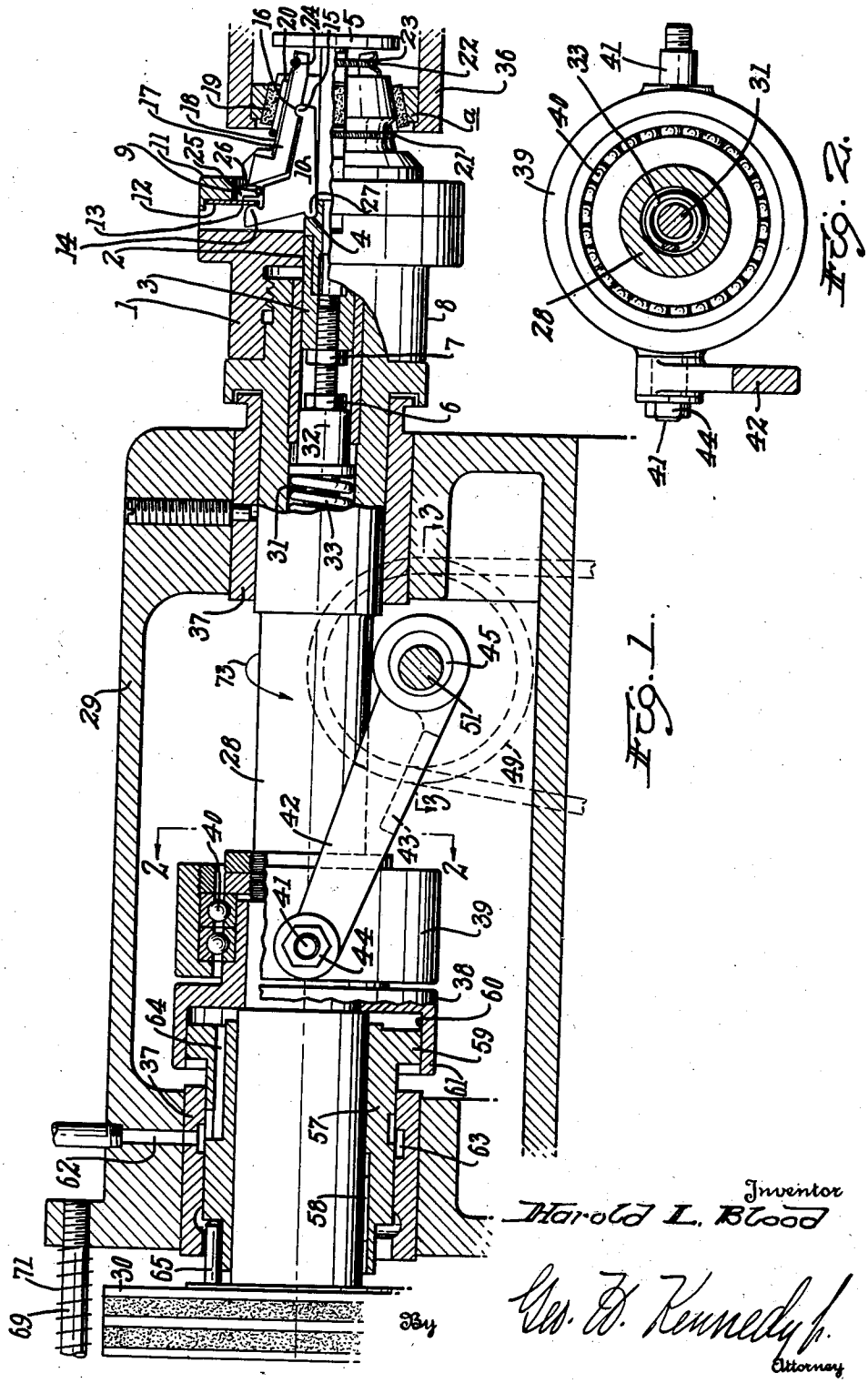


Fig. 1.

Fig. 2.

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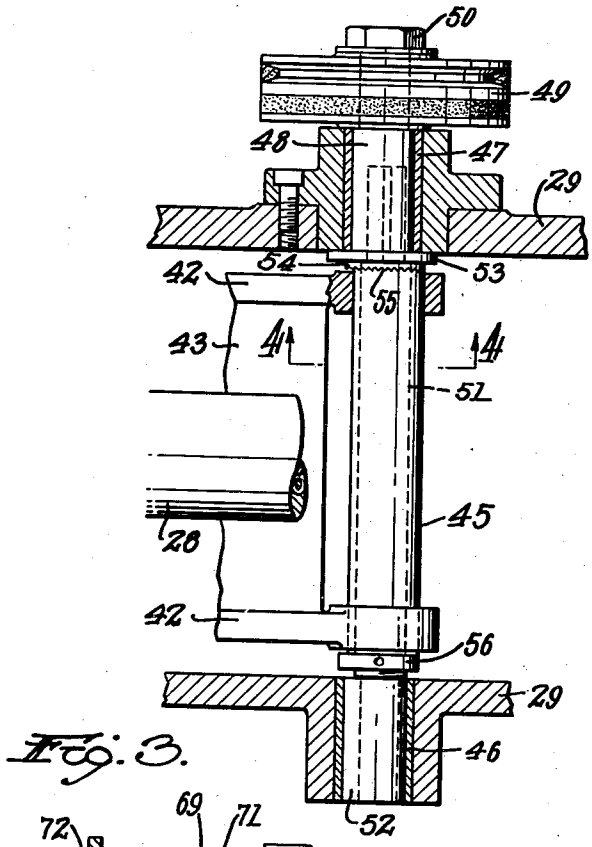


Fig. 3.

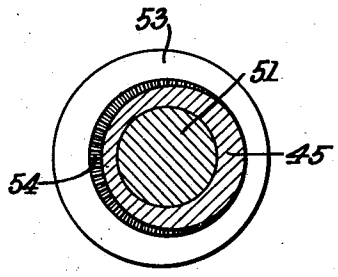


Fig. 4.

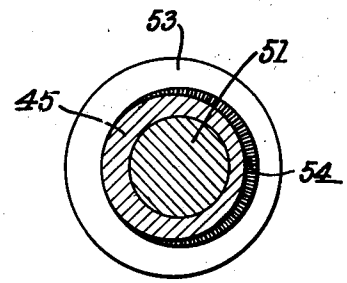


Fig. 5.

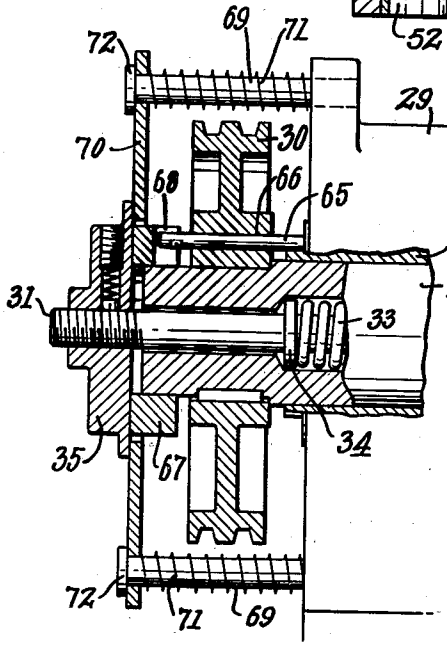


Fig. 6.

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UNITED STATES PATENT OFFICE

2,182,276

APPARATUS FOR HONING

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Application November 5, 1936, Serial No. 109,331

10 Claims. (Cl. 51—34)

The present invention relates to an apparatus for honing and especially to an arrangement by which a short rapid relative axial reciprocation between the hone and the workpiece may be provided while the honing action is taking place.

In the honing of cylindrical or tapered surfaces, it has been found desirable to combine with the usual relative rotation between workpiece and hone, a relative reciprocatory movement between the workpiece and the hone to produce a suitable surface finish on the workpiece which will be free of scratches and honing lines. Heretofore, such a reciprocation has, in general, been provided by mounting either the workpiece or the hone on the familiar reciprocatory table provided in machine tools for producing a relative movement between the work and the tool. This arrangement has been entirely satisfactory in operation, but in the construction of inexpensive honing apparatus, it is desirable to eliminate the reversing mechanism required for controlling the table movements. It is accordingly the principal object of the present invention to provide for an axial reciprocation of the honing members relative to the workpiece by a simplified arrangement capable of producing more rapid reciprocations than have heretofore been attainable, thus eliminating the need for any table or carriage movements except those necessary to present the work to the hone and to withdraw said work from honing position.

In the particular embodiment of the invention described, the hone is mounted on a spindle which is journalled in a honing head and the hone is reciprocated relative to the honing head and is also rotated by a rotation of the spindle. In order that the reciprocations may occur at the desired rate, a further feature of the invention resides in a provision for rotation of the hone independently of its reciprocation.

A further object of the invention is the provision for collapsing the hone, as at the completion of the honing operation, in order to withdraw the hone from the workpiece. The workpiece may thus be moved into operative relation to the hone before the hone is expanded into operative honing position.

In the copending application of Blood, Serial No. 100,911, filed September 15, 1936, which has become Pat. No. 2,146,414 dated Feb. 7, 1939, is disclosed an apparatus by which to compensate for wear on the honing stones. One object of the present invention is to provide an apparatus of this character which will function in connection with a reciprocatory spindle in adjusting the hone to compensate for wear thereon when such a compensation is necessary.

Other and further objects and advantages of the invention will more fully appear from the following detailed description taken in connection with the accompanying drawings in which—

Fig. 1 is a vertical sectional view through a honing head embodying the invention.

Fig. 2 is a sectional view along the line 2—2 of Fig. 1.

Fig. 3 is a horizontal sectional view along the line 3—3 of Fig. 1.

Fig. 4 is a sectional view along the line 4—4 of Fig. 3.

Fig. 5 is a sectional view corresponding to Fig. 4, with parts in a different relative position.

Fig. 6 is a vertical sectional view illustrating the parts associated with the hone-carrying spindle at the end remote from the hone.

Like reference characters refer to like parts in the different figures.

With reference first to Fig. 1, the hone which is of any suitable character, is arranged in the present disclosure for the honing of tapered internal surfaces and corresponds to the hone disclosed in the aforesaid Blood Patent No. 2,146,414. It is sufficient to note for the purpose of this application that the hone comprises a head or arbor 1 having an axial bore 2 in which a spindle 3 is slidable. The arbor has a key, not shown, by which to hold the spindle against rotation relative to the arbor, but to allow for axial movement of the spindle. The latter has an arcuate shoulder 4 within the arbor and the end of the spindle projects beyond the arbor and has a cap 5 secured thereto. The opposite end of the spindle receives an axially positioned bolt 6 for controlling the effective length of the spindle, the bolt being held against turning movement by a locking nut 7. A cylindrical hub 8 on the arbor provides for attachment of said arbor to the hone supporting and rotating mechanism hereinafter described. Although the spindle 3 is shown as made up of two separate members these members are functionally integral and are so described.

The arbor 1 has a plurality of radially extending slots 9 in each of which is positioned a lever 10 substantially of bell-crank form. Surrounding the arbor 1 adjacent the bases of the slots 9 is an annular member 11 the same being secured to the arbor by bolts, not shown, and between the arbor and the annular member is a disk 12 having a plurality of fingers 13 extending into the several slots 9. One end of each of the bell-crank levers 10 has an arcuate surface 14 for en-

gagement with the corresponding finger 13 to provide for rocking movement of the lever relative to the finger.

The opposite end of each lever has an arcuate lug 15 engageable in an arcuate recess 16 in an associated hone carrier 17. On the outer side of each of the carriers 17 is positioned a holder 18 to which is secured, as by a suitable adhesive, a honing member in the form of a stone 19, preferably of abrasive material. The stone is additionally held in place by flanges 20 extending outwardly from the holder.

The several holders 18 are retained against the carriers by coil springs 21 and 22, each in the form of an annulus. The spring 21 is positioned at the inner or left hand (Fig. 1) end of the holders and engages the flanges 20. The other coil spring 22 is positioned in a recess 23 in the outer end of each of the holders and the inturned portion of the holder which forms this recess engages in a correspondingly shaped recess 24 in the carrier. For additionally holding the levers 10 in position, a coil spring 25, also in the form of an annulus, is positioned in a slot 26 in the arbor 1 for engagement with all of the levers. At the corner of each bell-crank lever is an arcuate protuberance 27 engageable with the arcuate shoulder 4 on the spindle.

The hone above described is mounted on the end of a hollow shaft 28 journalled in a housing 29 and the shaft is driven in any suitable manner, as by means of a pulley 30 secured to the left hand end of the shaft. Within the shaft is an axially slidable rod 31 having a head 32 at the right hand end thereof engageable with the end of the bolt 6. A coil spring 33 surrounding said rod is positioned between the head 32 and a collar 34, Fig. 6, the latter being slidable on the rod, and normally urges said rod to the right for expanding the hone. Movement of the rod is limited by a nut 35, Fig. 6, on the threaded left hand end of the rod.

The above structure is all fully described and claimed in earlier patents or applications and is not of itself the present invention. The latter involves the attainment, in connection with the above, or similar machine elements, of the objects and novel features above outlined. In accordance therewith, the shaft 28 in addition to its rotary motion is arranged to have a relatively rapid reciprocation within the housing 29, so that the hone will be reciprocated as well as rotated when operating on the workpiece *a*. The latter is here shown as mounted non-rotatably in any suitable work-holding structure 36 which is movable in one direction to dispose the workpiece in operative relation with the hone, and in the other direction to withdraw said workpiece from honing position.

The shaft 28 is journalled in spaced bearings 37 in the housing 29 and is axially slidable therein. Secured to the shaft 28, between the bearings 37, is a collar 38 held against rotation on the shaft, and journalled on the collar 38 is a ring 39. Anti-friction bearings 40 assure a free rotation of the ring 39, but restrain the ring against axial movement on the shaft 28. As shown in Fig. 2, the ring 39 has oppositely projecting trunnions 41, on each of which is mounted a crank arm 42, the two arms being integrally connected by a connecting bar 43, Fig. 1. The crank arms are held on the trunnions 41 by nuts 44 and the opposite ends of the crank arms 42 are journalled on a sleeve 45 eccentrically mounted in the housing 29 beneath the shaft 28.

With reference now to Fig. 3, the housing 29 has spaced bearings 46 and 47 in the latter of which is journalled a stub shaft 48. A pulley 49 is secured to the outer end of the stub shaft, as by a clamping nut 50, and provides for rotation of the shaft 48. Eccentrically positioned in the inner end of the shaft 48 is the end of a spindle 51, the opposite end of the spindle having an eccentric sleeve 52 positioned in the bearing 46 and corresponding to the eccentricity of the shaft 48 relative to the spindle 51. As the bearings 46 and 47 are in alinement, the shaft 48 and eccentric sleeve 52 provide for an eccentric movement of the spindle 51 about the axis of the shaft 48. The sleeve 45 has an eccentric bore, the latter receiving the spindle 51, and this arrangement serves to impart a reciprocatory movement to the shaft 28 in response to rotation of the shaft 48.

To adjust the extent of reciprocation of the shaft 28 the sleeve 45 is mounted for angular adjustment on the spindle 51. To this end the stub shaft 48 has an integral flange 53 having a plurality of ratchet teeth 54 thereon to cooperate with corresponding ratchet teeth 55 on the end of the sleeve 45. A threaded collar 56 is positioned on the spindle 51 at the end of the sleeve 45 remote from the ratchet teeth and normally holds the cooperating ratchet teeth in interengagement. For adjustment of the sleeve 45 the collar 56 is loosened and the sleeve 45 can then be turned on the spindle 51. The showings of Figs. 4 and 5 indicate two extremes of adjustment for maximum length of reciprocatory strokes and for no reciprocation respectively.

With such a reciprocating hone, especially when same is arranged to operate in a workpiece bore that is straight rather than tapered, it is essential, for the movement of the workpiece into and out of honing position, to make provision for expanding and contracting the hone. To this end the shaft 28 has a sleeve 57 secured against turning movement thereon by a key 58 which allows axial movement of the sleeve. A projecting flange 59 on the sleeve 57 forms a piston slidable in a cylindrical bore 60 provided by the collar 38, the latter having a cylindrical flange 61 integral therewith. Fluid under pressure is directed through a channel 62 in the housing 29 from any suitable source to an annular groove 63 in the periphery of the sleeve 57 from which it is directed by a channel 64 to the cylindrical bore 60 to procure movement of the sleeve 57 to the left, Fig. 1, from the position shown.

With reference now to Fig. 6, a plurality of pins 65 extend through openings 66 in the pulley 30 and engage at their inner ends with a shoulder on the sleeve 57. At the outer ends the pins engage with a ring 67 positioned on the end of the shaft 28 and engaging with the underside of the nut 35. The ring 67 has slots 68 to receive the ends of the pins 65 and it will be apparent that when fluid under pressure enters the cylindrical bore 60 the ensuing left hand movement of sleeve 57 is communicated through nut 35 to the rod 31 and head 32, this compressing the spring 33 and allowing the springs 21 and 22 to collapse the hone. The admission of fluid under pressure to the bore 60 may be procured automatically as at the end of each honing operation, by any suitable structure, or may be procured manually by a suitable valve, not shown, which, during the honing operation, with the workpiece engaging the hones, will allow fluid under pressure to exhaust from within the cylin-

der bore. The springs 21 and 22 cause the hone to collapse when the rod 31 is moved to the left.

For compensating for wear on the honing stones the housing 29 has parallel studs 69, adjacent to the pulley end of the shaft 28, which support a plate 70 in engagement with the inner surface of the nut 35, the plate being resiliently urged to the left by coil springs 71 surrounding the studs. Movement of the plate to the left is limited by the heads 72 on the studs so that when the hone is collapsed the nut 35 will be out of engagement with the plate 70. In the normal honing operation the nut 35 may engage the plate 70, but frequently does not move far enough to the right under the action of the spring 33 to quite reach the plate 70. As the stones become more and more worn the nut 35 must move more and more to the right to allow the stones to engage with the work at a proper pressure, the expansion of the hone being limited ultimately by engagement between the nut 35 and the end of the shaft 28. After the hones are sufficiently worn to require a compensation for wear, the nut 35 moves far enough to the right to establish sufficient frictional contact between the plate 70 and the nut to cause a relative turning movement of the nut 35 on the end of the rod 31. The shaft 28 is rotated in the direction indicated by the arrow 73, Fig. 1, so that the relative turning movement of the nut 35 on the rod is in a proper direction to back the nut away from the end of the shaft 28, thereby allowing a further movement of the rod to the right and allowing the hone to be expanded somewhat more than before. This compensation can occur independently of the reciprocation of the shaft 28 as the nut 35 engages the plate 70 only when the shaft is at or near the right hand end of its movement, and the resilient mounting of the plate will allow a movement thereof when engaged by the nut.

From the foregoing it will be apparent that the present invention provides for rapid axial vibration of the spindle which carries the hone, thereby providing the desired combined rotary and reciprocatory motions between the hone and the workpiece. Furthermore, a fluid pressure actuated mechanism is provided for collapsing or expanding the hone when desired, as at the end of a honing operation. A compensatory mechanism is also provided to compensate automatically for the wear on the honing stones whenever a compensation for wear becomes necessary. It will be understood that the provision for reciprocation and rotation of the hone may be applied equally well to other forms of cutting tools where a simultaneous rotation and reciprocation relative to a workpiece is desired, as for example, in internal grinding machines.

I claim:

1. In a honing device, a honing head, a spindle mounted for reciprocation therein, a hone on the spindle, said hone comprising an arbor, a honing element carried by said arbor and movable relative thereto, means associated with the spindle for urging the honing element into operative position, and limiting means for controlling the operative position of the honing element and means for automatically compensating for wear on the hone by adjustment of said limiting means.

2. In a honing device, a honing head, a spindle mounted for reciprocation therein, means for rotating said spindle, means for reciprocating said spindle, a hone on said spindle, and means for automatically compensating for wear on the hone, said compensating means being actuated in part by the spindle rotation.

3. In a honing device, a head, a spindle mounted for reciprocation therein, a hone on the spindle, said hone comprising an arbor, at least one honing element carried by and movable relative to the arbor into and out of operative position, and means associated with the spindle for normally urging said element into operative position, means for controlling the operative position of said honing element, and means for automatically adjusting said last means to compensate for wear on the honing elements.

4. In a honing device, a head, a spindle mounted for reciprocation therein, a hone on the spindle, said hone comprising an arbor, at least one honing element carried by and movable relative to the arbor into and out of operative position, and means associated with the spindle for normally urging said element into operative position, means for controlling the operative position of said honing element, means for automatically adjusting said last means to compensate for wear on the honing elements, and means for procuring a retraction of the honing elements relative to the arbor.

5. In a honing device, a head, a spindle journalled in the head and reciprocable therein, a hone mounted on the spindle, said hone comprising an arbor, a lever mounted for rocking movement on the arbor and a honing element carried by the lever, resilient means positioned axially of the spindle for normally urging the honing element into operative position, and means for rendering said resilient means inoperative to procure a movement of the honing element into operative position, said last means including a piston and cylinder, one of which is carried by the spindle.

6. In a honing device, a head, a spindle journalled therein and reciprocable thereto, a hone mounted on the spindle, said hone comprising an arbor, at least one lever pivotally mounted in the arbor and a honing member carried by the lever, means extending axially of the spindle for urging the lever and the honing member thereon into operative position, and fluid pressure actuated means engageable with said last means for rendering said last means inoperative to procure movement of the honing element into inoperative position.

7. In a honing device, a head, a spindle journalled therein and reciprocable thereto, a hone mounted on the spindle, said hone comprising an arbor, at least one lever pivotally mounted in the arbor and a honing member carried by the lever, a rod extending axially of the spindle, resilient means engaging said rod for shifting the latter in the spindle to procure movement of the honing element into operative position, a threaded collar on the projecting end of said rod, and means engageable with said collar to procure a turning movement thereof in response to rotation of the spindle, thereby procuring adjustment of the position of the rod to compensate for wear on the honing element.

8. In a honing device, a head, a spindle journalled therein and reciprocable thereto, a hone mounted on the spindle, said hone comprising an arbor, at least one lever pivotally mounted in the arbor and a honing member carried by the lever, a rod extending axially of the spindle, resilient means engaging said rod for shifting the latter in the spindle to procure movement of the honing element into operative position, a thread-

ed collar on the projecting end of said rod, and a stationary plate mounted on the head and engageable by said collar during the axial reciprocation of the spindle, said plate procuring a turning movement of the collar on the rod in response to rotation of the spindle for adjusting the position of the rod within said spindle.

9. In a honing device, a head, a spindle journalled therein and reciprocable thereto, a hone mounted on the spindle, said hone comprising an arbor, at least one lever pivotally mounted in the arbor and a honing member carried by the lever, a rod extending axially of the spindle, resilient means engaging said rod for shifting the latter in the spindle to procure movement of the honing element into operative position, a threaded collar on the projecting end of said rod, and fluid pressure actuated means, including a piston and cylinder, one of which is connected to the spindle and the other of which is connected to the collar for shifting said collar and the rod axially of the spindle for procuring movement of the honing element into inoperative position.

10. In a honing device, a honing head, a spindle mounted for reciprocation therein, a hone on the end of the spindle, said hone comprising an arbor, a supporting member mounted for rocking movement relative to the arbor and a honing element mounted on the supporting member and movable therewith, means associated with the spindle for urging said supporting member and the honing element into operative position, means for controlling the operative position of said honing element, and cooperating means on the spindle and head for automatically adjusting said controlling means during reciprocation of the spindle.

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