May 2, 1933. E. A. ARP 1,906,241

METHOD AND APPARATUS FOR PREDETERMINING THE SIZE OF REBORED CYLINDERS

Filed Nov. 4, 1932 2 Sheets-Sheet 1

Fig. 1.

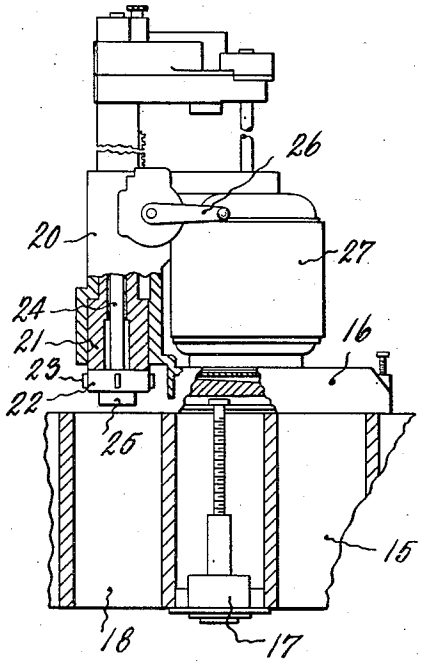


Fig. 2.

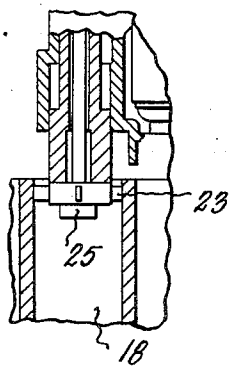


Fig. 3.

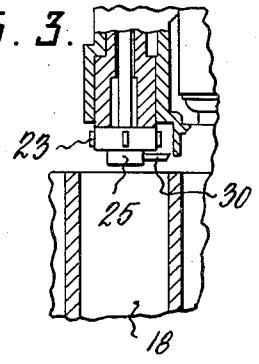


Fig. 4.

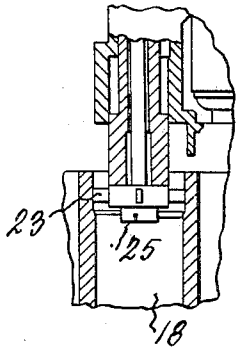


Fig. 6.

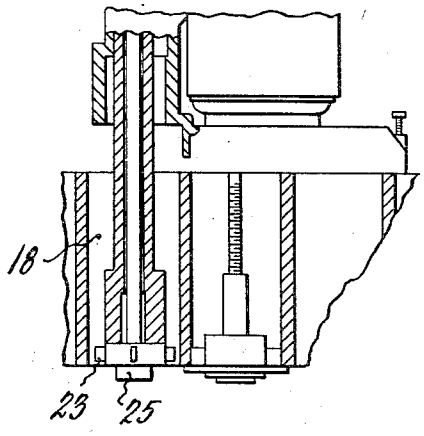
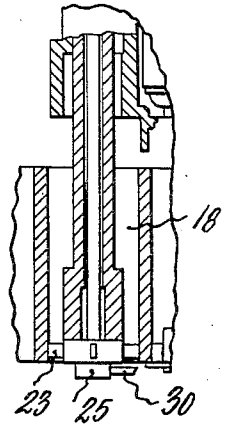


Fig. 5.



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METHOD AND APPARATUS FOR PREDETERMINING THE SIZE OF REBORED CYLINDERS

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Fig. 6a.

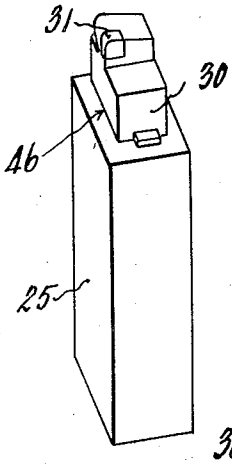


Fig. 7.

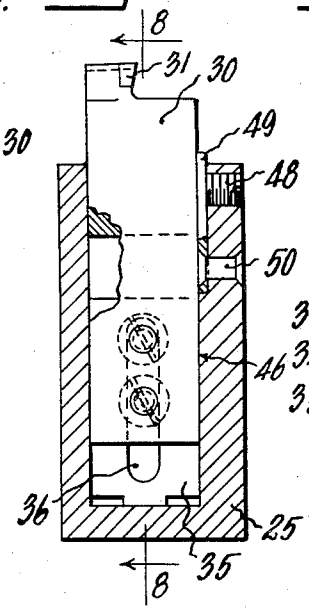


Fig. 8.

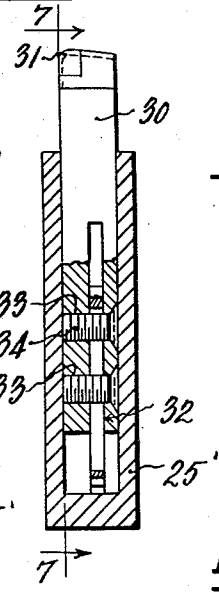


Fig. 9.

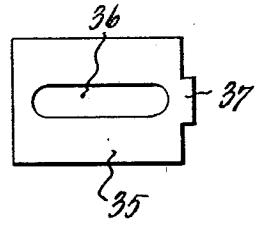


Fig. 10.

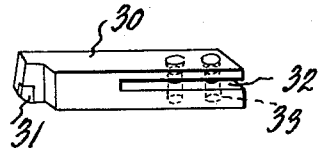


Fig. 11.

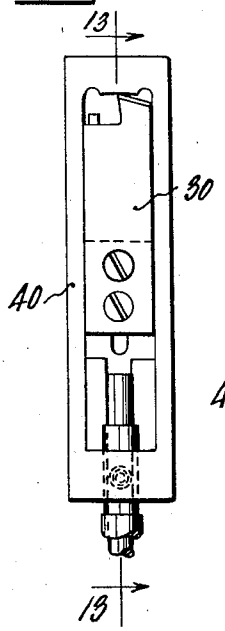


Fig. 12.

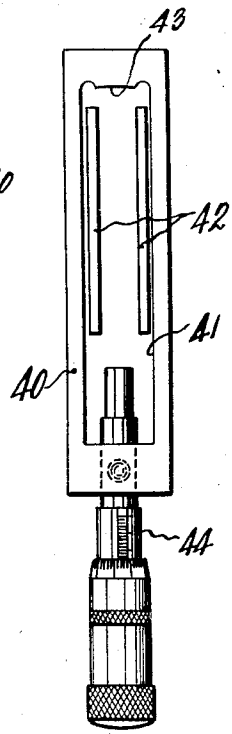


Fig. 13.

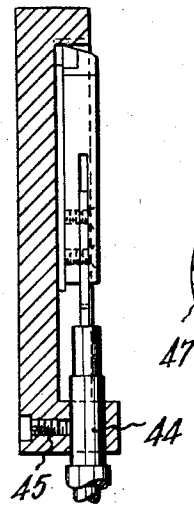
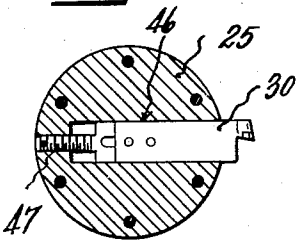


Fig. 14.



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Patented May 2, 1933

1,906,241

UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR PREDETERMINING THE SIZE OF REBORED CYLINDERS

Application filed November 4, 1932. Serial No. 641,212.

This invention relates to the art of boring cylinders and has particular reference to the reboring of worn cylinders of internal combustion motors. One object of the invention is to provide an improved method of predetermining the size of the rebored cylinder without the necessity of making measurements directly upon the cylinder while it is being machined. Another object is to provide an improved mechanism for facilitating the adjustment of the cutting mechanism while the cutter is removed from the boring device. A further object is to provide an improved method and apparatus by which a cutter can be adjusted under favorable conditions of light and accessibility to the exact condition necessary to produce a rebored cylinder of definitely predetermined size. Further objects of the invention will appear from the following description and claims.

The present application is a continuation in part of my prior application Serial No. 489,003, filed October 15, 1930.

Referring to the drawings,

Fig. 1 is a diagrammatic view illustrating the initiation of the reboring operation;

Figs. 2 to 6 inclusive are similar views showing successive stages in the reboring of the cylinder;

Fig. 6*a* is a perspective view of a cutting tool and a holder therefor;

Fig. 7 is a section through the cutter and its holder taken on line 7—7 of Fig. 8;

Fig. 8 is a section on line 8—8 of Fig. 7;

Fig. 9 is a detail of an adjusting slide;

Fig. 10 is a perspective detail of the tool shank with the adjusting slide removed;

Fig. 11 is a detail of the tool shank and its adjusting slide in position in an adjusting fixture;

Fig. 12 is a similar view of the adjusting fixture with the tool shank removed;

Fig. 13 is a section on line 13—13 of Fig. 11; and

Fig. 14 is a sectional plan showing the cutter inserted in a slightly different form of tool holder.

Referring first to Figs. 1 to 6 inclusive, a cylinder block 15 is shown upon which is placed the base 16 of a boring device which may in its general features be similar to that shown in my Patent No. 1,868,440 dated July 19, 1932. This base is held to the cylinder block by an anchor 17 preferably of the type shown in my prior patent. The reboring machine is formed with a guide 20 in which a sleeve 21 is mounted for vertical reciprocation. At its lower end the sleeve carries a guide or centering head 22 provided with a circumferential series of radially movable guide fingers 23 which can be controlled in their position by mechanism at the top of the machine as pointed out in my patent referred to. Passing through the sleeve and freely rotatable within it is a cutter shaft 24 carrying at its lower end a cutter head. This cutter head may be circular in form as shown at 25 in Figs. 1 to 6 and 14 or may be rectangular as shown at 25′ in Figs. 6*a*, 7 and 8. The sleeve, carrying the rotatable cutter head with it, can be raised or lowered by a hand lever 26 or automatically by a motor 27 by means of mechanical details which it is not necessary to describe here.

Before considering the method by which the cylinder is rebored one preferred construction of the cutter head will be described with particular reference to Figs. 6*a* to 13. In these figures is shown a tool shank 30 having a cutting element 31, usually of tungsten carbide, brazed to it at one end. The shank is slotted as at 32 and is provided with holes 33 threaded at one side of the slot to receive screws 34, and countersunk at the other side to receive the screw heads. An adjusting slide 35 is adapted to fit within the slot 32 and is itself slotted at 36 to permit the passage of the screws 34. The adjusting slide 35 may be moved to any desired longitudinal position while the screws 34 are loosened, but upon the tightening of these screws it will be firmly clamped in position by the drawing together of the two walls of the slot 32. The adjusting slide is preferably provided at one end with an abutment 37 having a purpose to be described below.

In Figs. 11, 12 and 13 is shown an adjusting fixture by means of which the combined length of the tool shank and the adjusting slide projecting therefrom can be accurately

determined and set. This fixture is centrally grooved at 41 to form a pocket for the reception of the tool shank, the bottom of the pocket being preferably provided with ribs 42 upon which the tool shank rests. At one end the pocket terminates in an abutment 43, against which the cutting point 31 may rest. At the other end of the fixture a micrometer 44 is secured by a set screw 45. With the screws 33 loosened the tool shank is set within the pocket of the adjusting fixture and the micrometer screwed in until the adjusting slide 35 is moved into the desired position as indicated by the reading of the micrometer graduations. The screws 33 are then clamped fixing the combined length of the tool shank and the adjusting slide at the desired amount.

The reboring operation will now be considered in detail. The boring device is first set upon the cylinder block with the cutter head above the cylinder to be rebored. With the cutter shank removed from the cutter head and with the guide fingers 23 retracted the sleeve 21 is first lowered into the cylinder as in Fig. 2 and the guide fingers expanded. When all the guide fingers are in contact with the cylinder wall the axis of the cutter shaft is necessarily concentric with the cylinder and the anchor 17 is then tightened to clamp the entire reboring mechanism in that position. The combined length of the tool shank and the adjusting slide is now adjusted by the micrometer fixture until the micrometer reading shows the correct amount to give the rebored cylinder the size desired and after the screws 33 are clamped down the tool shank is removed from the fixture and inserted within a socket 46 in the cutter head. The abutment 37 on the adjusting slide may rest against the bottom of the socket as in Fig. 7 or may rest against an adjusting screw 47 as in Fig. 13. In either case the abutment formed by the end of the socket or by the end of the set screw may be considered a permanent position at a fixed distance from the axis of the cutter shaft 24. The micrometer is preferably graduated so that its reading does not determine the length of the cutter shank plus its adjusting slide but shows the radius or diameter of the cylinder to be rebored. In either case it will be clear that when the tool shank is once adjusted and placed within the socket 46 the cutting point will be located with great accuracy at a predetermined radius from the axis of the shaft. This radius is determined by the addition of the distance of the abutment from the axis of the support and the length of the adjusted tool shank. If the socket is radial and does not cross the axis the addition will be arithmetical. If it is radial and does cross the axis the addition is algebraic. If the socket is not radial the addition is vectorial, this case being generic and the two others being special cases under it. The tool shank may be clamped in the socket as by a set screw 48 bearing upon a strip 49 loosely secured to the socket wall as at 50 or it may be made a smooth sliding fit in the socket as shown in Fig. 14, the pressure of the cutting operation keeping the tool shank firmly against the abutment at the bottom of the socket.

The guide fingers 23 are now retracted, the sleeve 21 raised to carry the guide fingers and the cutter head clear of the cylinder block and the adjusted cutter shank inserted as in Fig. 3. It may be pointed out here that in Figs. 1 to 6 the dimensions of the various parts are very much exaggerated in order to give contrast and make the description clear. The cutter shaft is now started into operation and is lowered gradually in the cylinder. Initially the guiding of the cutter head is taken care of by the bearing of the sleeve 21 in the frame of the reboring mechanism. As soon however, as a length of cut has been taken sufficient to bring the guide fingers 23 within the cylinder wall they are expanded so as to contact with the freshly bored part of the cylinder. During the remainder of the cutting operation the cutter is guided by these fingers (Fig. 5). When the end of the cylinder has been reached the movement of the parts is stopped, the guide fingers retracted as in Fig. 6, the anchor loosened, the mechanism shifted to bring the cutting point 31 away from the cylinder wall, and the sleeve and cutter head moved back up through the cylinder.

What I claim is:

1. A mounting for cutting tools permitting size adjustment of the tool while removed from the machine in which it is used, comprising a holder adapted for permanent association with the machine and having a permanently located tool positioning abutment, a tool having a cutting edge at one end and a fork at the other, a slide frictionally movable in the fork and having at its end remote from the cutting edge of the tool a positioning abutment adapted for cooperation with the tool positioning abutment of the holder, means for clamping the slide against movement in the fork, and means for clamping the assembled and adjusted tool and slide unit in the holder.

2. A mounting for cutting tools permitting size adjustment of the tool while removed from the machine in which it is used, comprising a socketed holder adapted for permanent association with the machine, the bottom of the socket serving as a permanently located tool positioning adjustment, a tool having a cutting edge at one end and a fork at the other, a slide frictionally movable in the fork and having at its end remote from the cutting edge of the tool a positioning abutment adapted for cooperation with the tool positioning abutment of the holder, means for clamping the slide against movement in the

fork, a plate in the socket yieldable towards the tool but restrained against movement lengthwise of the socket, and a clamp screw bearing against said plate for securing the tool firmly within the socket without causing displacement of the tool as the screw is being tightened.

3. A precision method of reboring the cylinders of internal combustion motors and the like to a predetermined size with a boring implement of the type having a rotatably and axially movable cutter carrier adapted, when the implement is clamped to a cylinder block with the axis of the cutter carrier in accurate alignment with the axis of the cylinder to be rebored, to carry a cutting tool in a helical path through said cylinder; said method comprising adjusting an extensible cutting tool by calipering while removed from the carrier so as to fix to a predetermined dimension the distance between the cutting edge of the tool and an abutment contacting portion thereof, and then placing the cutting tool in the cutter carrier with the abutment contacting portion thereof in contact with an abutment on the carrier, the length of the cutting tool from its cutting edge to its abutment contacting portion when added vectorially to the distance between the abutment and the axis of rotation of the support giving a distance between the axis of the support and the cutting edge of the tool equal to the radius desired for the finished cylinder, whereby when the tool is rotated and moved axially through the cylinder with its axis held firmly in alignment with that of the cylinder the walls of the cylinder will be cut accurately to the predetermined size for which the cutter was adjusted.

4. In a cylinder reboring machine of the type having a boring bar rotatably and longitudinally movable in a base provided with means for clamping it upon an engine block with the axis of the boring bar in alignment with the axis of the cylinder to be rebored; a mounting for a boring tool permitting the reboring of the cylinder to a predetermined diameter determined by adjustment of the boring tool while removed from the cylinder and without direct measurement of the cylinder being rebored, comprising a holder adapted for permanent association with the boring bar and provided with a tool receiving socket opening laterally of the boring bar, a tool positioning abutment located within the socket at a point remote from the open end thereof, a boring tool having a cutting edge at one end, and a member adjustably secured to the tool and having an abutment of less area than the open end of the socket and adapted to contact with the tool positioning abutment within the socket, whereby the tool and member may be adjusted when removed from the machine and when inserted in the socket as a unit with the abutments in contact the cutting edge of the tool will be located at a predetermined distance from the tool positioning abutment and therefore at a predetermined distance from the axis of the boring bar so that when the boring bar is rotated and advanced through the cylinder the latter will be rebored to an exact predetermined diameter.

5. In a cylinder reboring machine of the type having a boring bar rotatably and longitudinally movable in a base provided with means for clamping it upon an engine block with the axis of the boring bar in alignment with the axis of the cylinder to be rebored; a mounting for a boring tool permitting the reboring of the cylinder to a predetermined diameter determined by adjustment of the boring tool while removed from the cylinder and without direct measurement of the cylinder being rebored, comprising a holder adapted for permanent association with the boring bar and provided with a socket opening laterally of the boring bar, a tool positioning abutment located within the socket at a point remote from the open end thereof, a boring tool having a cutting edge at one end, a member slidably coupled to the tool and having at a point remote from the cutting edge of the tool an abutment adapted to contact with the tool positioning abutment of the holder, and means for clamping the tool and said member in longitudinally adjusted position while removed from the holder, whereby the tool and member may be adjusted and clamped when removed from the machine and when inserted in the socket as a unit with the abutments in contact the cutting edge of the tool will be located at a predetermined distance from the tool positioning abutment and therefore at a predetermined distance from the axis of the boring bar so that when the boring bar is rotated and advanced through the cylinder the latter will be rebored to an exact predetermined diameter.

6. In a cylinder reboring machine of the type having a boring bar rotatably and longitudinally movable in a base provided with means for clamping it upon an engine block with the axis of the boring bar in alignment with the axis of the cylinder to be rebored; a mounting for a boring tool permitting the reboring of the cylinder to a predetermined diameter determined by adjustment of the boring tool while removed from the cylinder and without direct measurement of the cylinder being rebored, comprising a holder adapted for permanent association with the boring bar and provided with a socket opening laterally of the boring bar and having boring tool engaging and confining walls, a tool positioning abutment located within the socket at a point remote from the open end thereof, a boring tool having a cutting edge at one end and shaped so as to bear directly

against the walls of the socket, so that the tool will receive support directly from the holder in all adjusted positions, and a member adjustably secured to the boring tool and having an abutment adapted to contact with the tool positioning abutment within the socket, whereby the tool and member may be adjusted when removed from the machine and when inserted in the socket as a unit with the abutments in contact the cutting edge of the tool will be located at a predetermined distance from the axis of the boring bar so that when the boring bar is rotated and advanced through the cylinder the latter will be rebored to an exact predetermined diameter with the cutting tool steadied and held directly by the holder.

7. In a cylinder reboring machine of the type having a boring bar rotatably and longitudinally movable in a base provided with means for clamping it upon an engine block with the axis of the boring bar in alignment with the axis of the cylinder to be rebored; a mounting for a boring tool permitting the reboring of the cylinder to a predetermined diameter determined by adjustment of the boring tool while removed from the cylinder and without direct measurement of the cylinder being rebored, comprising a holder adapted for permanent association with the boring bar and provided with a socket opening laterally of the boring bar and having boring tool engaging and confining walls, a tool positioning abutment located within the socket at a point remote from the open end thereof, a boring tool having a cutting edge at one end and shaped so as to bear directly against the encircling walls of the socket so that the tool will receive support directly from the holder in all adjusted positions, a member slidably coupled to the tool and having at a point remote from the cutting edge of the tool an abument of less area than the open end of the socket and adapted to contact with the tool positioning abutment within the socket, and means for clamping the tool and said member in longitudinally adjusted position while removed from the holder, whereby the tool and said member may be adjusted and clamped when removed from the machine and when inserted in the socket as a unit with the abutments in contact the cutting edge of the tool will be located at a predetermined distance from the tool positioning abutment and therefore at a predetermined distance from the axis of the boring bar with the cutting tool steadied and held directly by the encircling walls of the holder, so that when the boring bar is rotated and advanced through the cylinder the latter will be rebored to an exact predetermined diameter.

In testimony whereof I have affixed my signature.

EWALD A. ARP.

DISCLAIMER

1,906,241.—*Ewald A. Arp*, Minneapolis, Minn. METHOD AND APPARATUS FOR PREDETERMINING THE SIZE OF REBORED CYLINDERS. Patent dated May 2, 1933. Disclaimer filed February 13, 1935, by the assignee, *Van Norman Machine Tool Company.*

Therefore, enters the following disclaimer:

To the language appearing at page 2, lines 62 to 65 of the specification of said Letters Patent, to wit: "If the socket is not radial the addition is vectorial, this case being generic and the two others being special cases under it."

To any method of reboring cylinders as defined in claim 3 of said Letters Patent except when the adjusted setting of the cutting tool to produce a predetermined size of rebored cylinder is completely and directly determinable by calipering the tool along a line substantially in the direction of extension of the tool while the tool is removed from the carrier and when said calipered length is substantially radial with respect to the axis of rotation of the cutter carrier when the adjusted tool is placed therein.

To the word "vectorially" appearing in line 21 of claim 3.

To any cylinder reboring machine as defined in claims 4, 5, 6, and 7 of said Letters Patent except when the socket in the holder is substantially radial with respect to the axis of rotation of the boring bar and when the adjusted setting of the cutting tool to produce a predetermined size of rebored cylinder is completely and directly determinable by calipering the tool and the member adjustably secured to it while said tool and member are removed from the machine.

[*Official Gazette March 12, 1935.*]