July 30, 1935. T. THORSEN 2,009,822

BORING MACHINE

Filed Jan. 20, 1932 2 Sheets-Sheet 1

Fig. 1

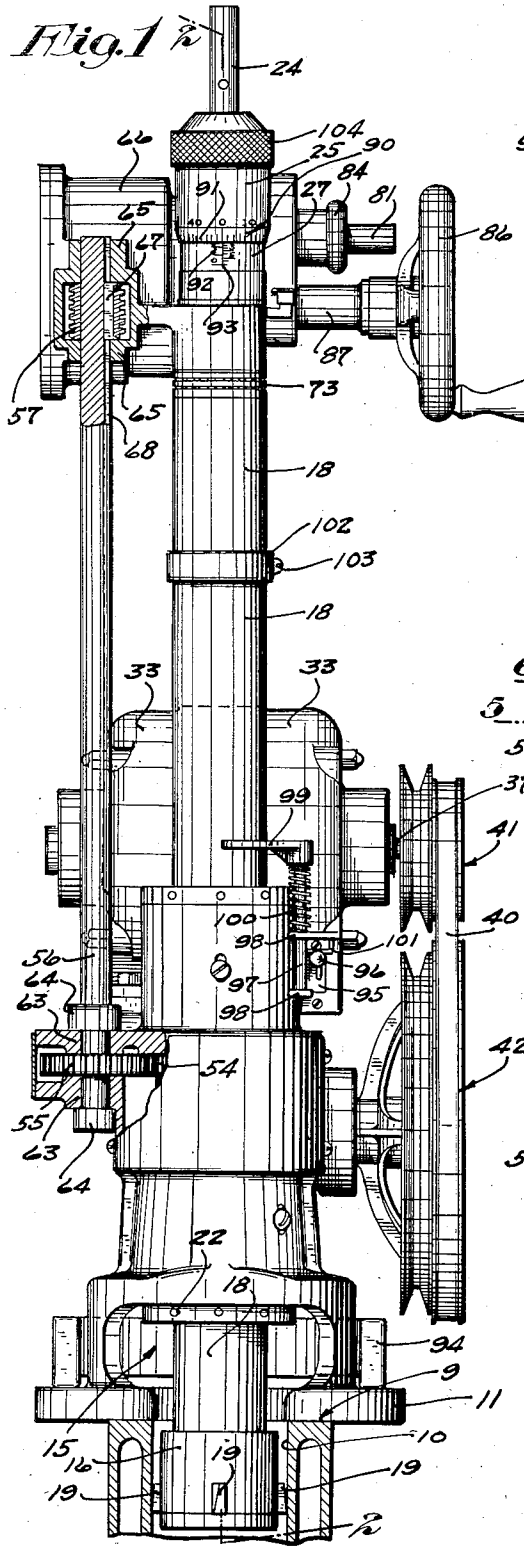


Fig. 7

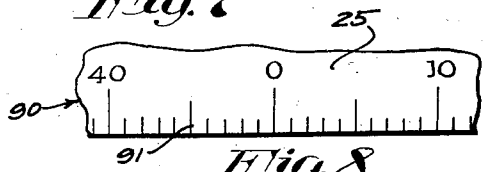


Fig. 8

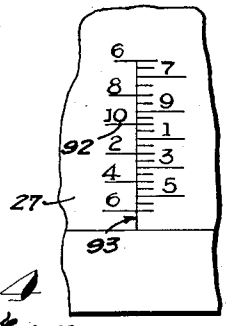


Fig. 6

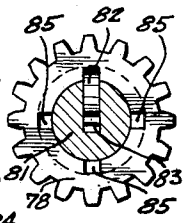


Fig. 4

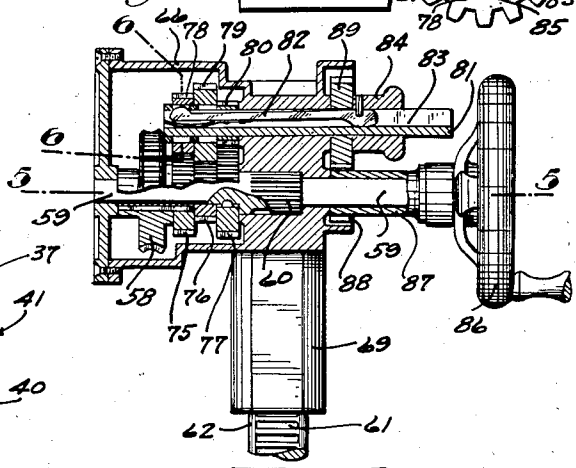
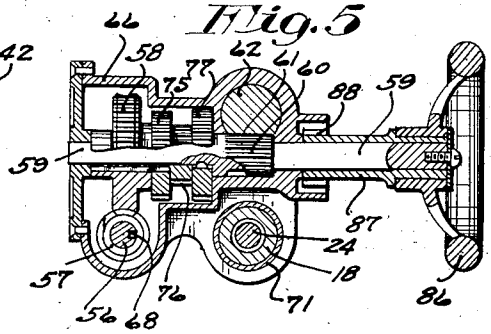


Fig. 5



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July 30, 1935. T. THORSEN 2,009,822

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Filed Jan. 20, 1932 2 Sheets-Sheet 2

Fig. 2

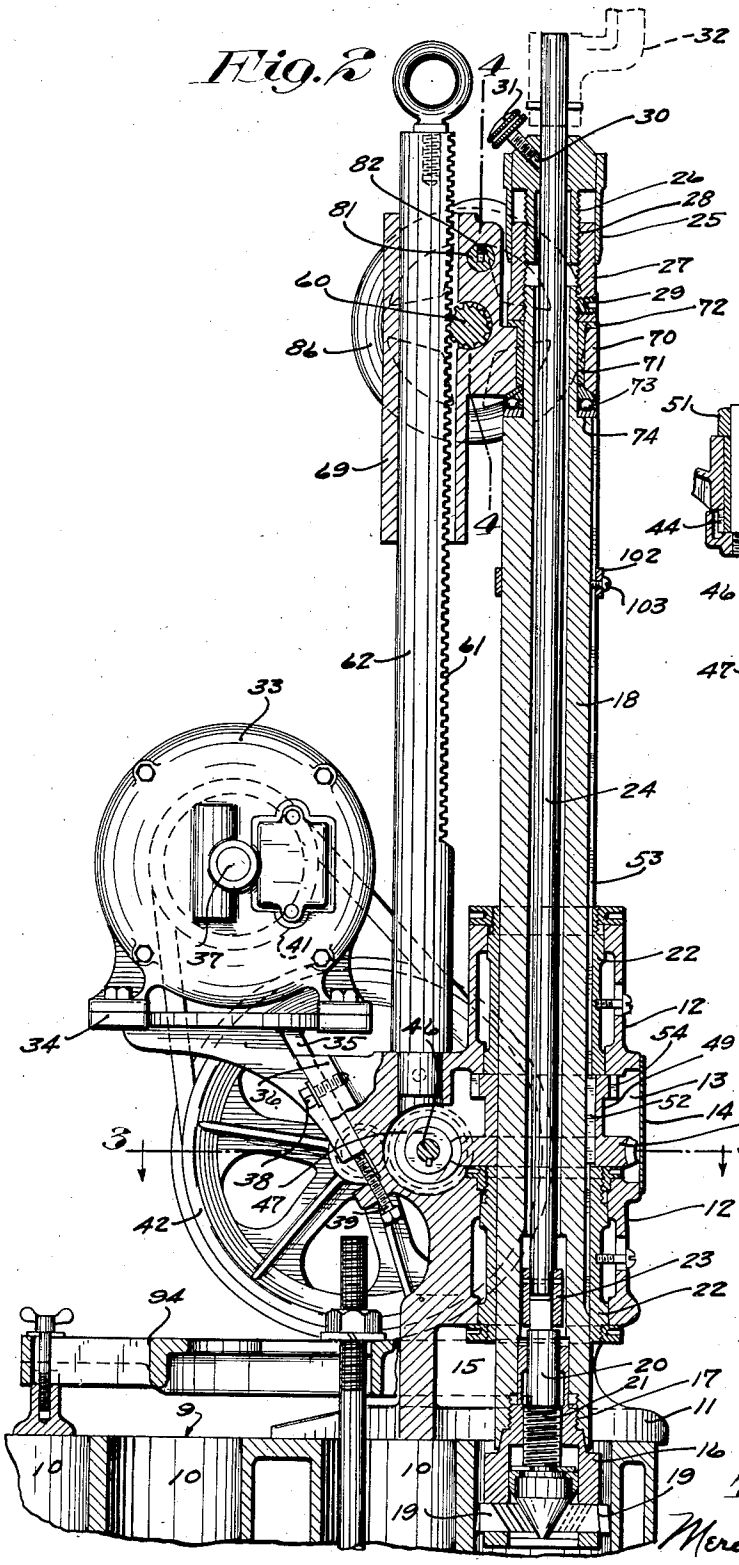
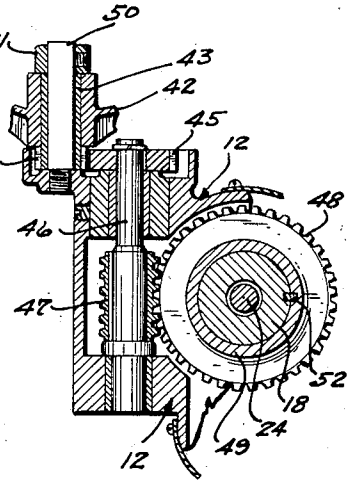


Fig. 3



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Patented July 30, 1935 2,009,822

UNITED STATES PATENT OFFICE

2,009,822

BORING MACHINE

Thor Thorsen, Minneapolis, Minn., assignor to Storm Manufacturing Co., Inc., Minneapolis, Minn., a corporation of Minnesota

Application January 20, 1932, Serial No. 587,708

1 Claim. (Cl. 77—2)

My present invention relates to boring machines and more particularly to a boring machine for reestablishing, reboring and refinishing bores in an engine cylinder block of accurate size and alignment. The object of the invention is to provide a portable, self-contained, power-operated boring machine that is highly efficient and of compact form which permits the machine to be mounted on an engine cylinder block without removing said block from the chassis of an automotive vehicle and where it is necessary to work close to the cowl and other parts of the vehicle.

To the above end, generally stated, the invention consists of the novel devices and combinations of devices hereinafter described and defined in the claim.

In the accompanying drawings, which illustrate the invention, like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a front elevation of the improved boring machine mounted on an engine cylinder block, some parts being broken away and sectioned;

Fig. 2 is a view principally in section taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary detail view with some parts sectioned on the line 3—3 of Fig. 2;

Fig. 4 is a detail view partly in elevation and partly in section taken on the line 4—4 of Fig. 2;

Fig. 5 is a view partly in plan and partly in horizontal section taken on the line 5—5 of Fig. 4;

Fig. 6 is a detail view, on an enlarged scale, with some parts sectioned on the line 6—6 of Fig. 4; and

Figs. 7 and 8 are fragmentary detail views showing the micrometer.

The improved boring machine, as shown in the drawings, is mounted on an engine cylinder block and indicated, as an entirety, by the numeral 9 with the exception of its cylinders 10.

The base 11 of the boring machine is designed to rest on the flat top of the cylinder block 9 and support said machine perpendicular thereto. This base 11 has a hollow raised central portion which supports an upstanding open-ended substantially cylindrical housing 12 that is integral therewith. This housing 12 has at its vertical center a gear compartment 13 having an open front normally closed by a displaceable cover plate 14. Circumferentially spaced sight openings 15 are formed in the raised central portion of the base 11.

A novel multiple cutter head 16 is detachably secured by screw-threads, as indicated at 17, to the lower end of a long upright cylindrical boring bar 18. This cutter head 16 is the subject matter of an application executed by me of even date herewith and for the purpose of this case it will only be necessary to note its radially projecting cutter blades 19 and pilot 20 which has screw-threaded engagement with said head, as indicated at 21. By projecting the pilot 20 the cutters 19 will be projected and suitable means, not shown, will be provided for retracting the cutters 19 when the pilot 20 is retracted. The boring bar 18 is journaled at its lower end portion in upper and lower axially spaced and axially aligned bearings 22 in the housing 12 and located, the former above the compartment 13 and the latter below the same. These bearings 22 are rigidly and adjustably secured to the housing 12.

The pilot 20 extends axially through the cutter head 16 in axial alignment with the boring bar 18 and projects above said cutter head and is detachably secured by a coupling 23 to a long operating rod 24 by which the pilot 20 may be turned in the cutter head 16 to project or retract the same. The operating rod 24 extends axially through the boring bar 18, is out of contact therewith and projects above the upper end thereof. This operating rod 24 at its upper end portion extends through an axial hole in the top of a micrometer thimble 25 which thimble affords a bearing therefor. A depending tubular stem 26 integral with the under side of the top of the thimble 25 loosely surrounds the operating rod 24 and extends axially into a detachable top extension 27 of the boring bar 18, is connected thereto by screw-threads 28 for axial adjustment thereon, and is normally held from turning with respect thereto by a set-screw 29. It may be here stated that the screw-threads 21 and 28 are of the same number per inch.

Normally the micrometer thimble 25 is locked to the operating rod 24 for rotation therewith by a wedge-acting pin 30 and a cooperating thumb-screw 31. This pin 30 is loosely mounted in an oblique bore in the top of the thimble 25 and impinges against the operating rod 24. The thumb-screw 31 extends into said bore, has screw-threaded engagement with the thimble 25 and impinges against the wedge pin 30 and holds the same in frictional contact with the operating rod 24 with sufficient pressure to cause the thimble 25 to rotate with said rod.

A hand-crank 32 detachably applied to the upper end of the operating rod 24, and fragmentarily illustrated in Fig. 2 by means of broken lines, is provided for manually turning said

rod to project or retract the pilot 20 for adjusting the cutter 19.

Operating connections from an electric motor 33 are provided for simultaneously rotating the boring bar 18 and axially moving the same to impart like movements to the cutter head 16. This electric motor 33 has a base 34 provided with a depending slide 35 mounted in an upwardly and outwardly inclined way 36 on the back of the housing 12. The surface of the way 36 on which the slide 35 moves is on a line that radiates from the axis of the armature shaft 37 of the motor 33. A pair of set-screws 38 adjustably but rigidly secure the slide 35 to the way 36 and said slide rests on a slow motion screw 39 having screw-threaded engagement with an extension on the way 36. Obviously by turning the screws 39 the motor 33 may be raised or lowered to act as a belt tightener as will hereinafter appear.

Referring first to the operating connections from the motor 33 for rotating the boring bar 18 about its longitudinal axis, the same includes a belt 40 arranged to run over a relatively large pulley 42 loose on the long hub 43 of a spur pinion 44 which meshes with a spur gear 45 keyed to a shaft 46 having a worm 47 which meshes with a worm gear 48, the hub 49 of which is mounted on the boring bar 18. As shown, the pulleys 41 and 42 have variable speed grooves into which the belt 40 may be shifted to drive the boring bar 18 at different speeds, see Fig. 1. This belt 40 may be tensioned by manipulating the screw 39 heretofore referred to.

The worm 47 has a double thread thus doubling the speed at which the boring bar would be rotated by a single thread worm and the ratio of the pinion 44 and gear 45 is such as to reduce the speed of the worm 47 so that it turns the boring bar 18 at the same speed at which it would be rotated by a single thread worm. The purpose of providing the worm 47 with a double thread is to reduce the friction between said worm and the worm gear 48 and increase the power delivered to the worm gear 48 by the worm 47.

The hub 43 is journaled on a stub shaft 50 rigidly secured to the housing 12 and the shaft 46 is journaled in a pair of axially aligned bearings in said housing and the worm 47 is secured to the shaft 46 between its bearings, see Fig. 3. A fixed collar 51 on the outer end of the shaft 50 holds the pulley 42 on the hub 43 against outward axial movement on said shaft.

The hub 49 is mounted on the boring bar 18 between the two bearings 22 and is held thereby against axial movement. This hub 49, and hence the worm gear 48, is held for rotation with the boring bar 18 but with freedom to permit said boring bar to move axially therethrough by a key 52 secured in said hub and slidably mounted in a long keyway 53 in the boring bar 18.

Referring now to the operating connections for feeding the boring bar 18 axially during its rotation the same includes a spur gear 54 on the hub 49 which meshes with a spur gear 55 fixed on the lower end of an upright shaft 56 having on its upper end a worm 57 which meshes with a worm gear 58 loose on the shaft 59 having a fixed spur pinion 60 which meshes with a rack 61 on a fixed upright post 62. The shaft 56 extends parallel to the axis of the boring bar 18 and its lower end portion is journaled in a pair of bearings 63 formed with the housing 12, one above and the other below the gear 55.

A pair of collars 64 on the shaft 56 engage the outer faces of the bearings 63 and hold said shaft against axial movement. The upper end portion of the shaft 56 is journaled in a pair of axially spaced bearings 65 on a cross-head 66 with freedom to permit vertical movement of said head thereon. The worm 57 is secured to the shaft 56 for rotation therewith by a key 67 which works in a long keyway 68 in said shaft. The cross-head 66 is carried by the boring bar 18 and has a long sleeve bearing 69 which slides on the post 62 during axial feeding movement of said boring bar. This cross-head 66 is provided with a hub 70 having a bushing 71 in which the reduced upper end portion of the boring bar 18 is turnably mounted. Formed on the upper end of the bushing 71 is an outturned annular flange 72 which has a working fit between the hub 70 and the lower end of the boring bar extension 27 and holds said head against lifting movement on the boring bar 18. A thrust bearing 73 is interposed between the lower end of the bushing 71 and an annular shoulder 74 on the boring bar 18 and the boring bar 18 has free turning movement in said bushing.

Variable speed transmission mechanism from the worm gear 58 to the shaft 59 includes differential spur gears 75, 76 and 77 which mesh with spur gears 78, 79 and 80, respectively. The gears 58, 75 and 76 are all connected for common rotation and mounted for rotation on the shaft 59 and the gear 77 is keyed to said shaft. The gears 78 and 79 are loosely mounted on a shaft 81 for independent rotation and the gear 80 is keyed for rotation therewith and said shaft is mounted in a bearing on the cross-head 66 and extends parallel to the shaft 59.

A sliding key 82 mounted for endwise sliding movement in a long keyway 83 in the shaft 81 is provided for connecting either one of the gears 78 and 79 to said shaft for rotating the same from the gear 58. The key 82 is provided with a knob 84 by which it may be shifted from neutral within the gear 80 to a position in which it projects into any one of a plurality of circumferentially spaced keyways 85 in the gears 78 or 79 to connect either one thereof to the shaft 59.

To manually operate the pinion 60 to raise or lower the cross-head 66, and hence the boring bar 18 and its cutter head 16, there is provided a hand wheel 86 rigidly secured to a bearing 87 on the shaft 59 and having a spur pinion 88 which meshes with a spur gear 89 keyed to the shaft 81.

The micrometer heretofore mentioned is for use in positioning the operating rod 24 when manipulated to set the cutters 19 for a predetermined cut. The skirt of the micrometer thimble 25 is telescoped with a working fit onto the boring bar extension 27, which forms a part of the micrometer. This skirt of the thimble 25, at its bottom, its inwardly and downwardly beveled to a sharp edge, which closely engages the exterior of the boring bar extension 27 and affords the body 90 of a vernier 91, which circumferentially divides the body 90 into fifty equal parts, each part or graduation representing one-thousandth of an inch of the diameter of the cutter. The micrometer further includes a vertical scale 92 on the boring bar extension 27 having equal graduations reading from the top down and each graduation represents fifty-one thousandths of an inch or one complete turn of the micrometer thimble 25 and also one complete turn of the pilot 20 when said thimble is secured to the operating rod 24 for rotation therewith. This scale 92 also includes a vertical reading line 93 for the vernier 91. The scale 92, reading from the top down, has every other graduation designated as follows:

6—7—8—9—10—1—2—3—4—5—6 and each numeral represents a certain number of thousandths to wit: 6—six one-hundred one-thousandths of an inch, 7—seven one-hundred one-thousandths of an inch, etc. 10 will be an even number of known inches.

For the purpose of this case it may be assumed that the diameter of the smallest cut that can be made by the commercial form of the cutter head 16 is two and five-eighths inches. Taking this dimension as an arbitrary working point the third graduation on the scale 92, designated by the numeral 7, will indicate that the diameter of the cut that the cutters 19 will make when the micrometer thimble 25 is adjusted with its reading edge on the graduation designed by this numeral and the zero point of the vernier 91 on the reading line 93, is two and seven one-hundred thousandths of an inch. If the diameter of the cut to be made is say, two and seven hundred one-ten thousandths of an inch, the thimble 25 will be turned on the boring bar extension 27 to bring the vernier graduation 10 into registration with the reading line 93. For each complete rotation of the thimble 25, the same will be moved downward on the scale 92 one space, or in other words, one-fifty thousandths of an inch. According to the reading of the micrometer in Fig. 1 the cutter blades 19 are set to cut the cylinder to a diameter of 3.100 inches.

As previously stated, the screw-threads 28 on the thimble stem 26 and the screw-threads 21 on the pilot 20 are of the same number per inch and the face of the conical member of the pilot 20 has a predetermined angle to the axis of the pilot 20 to project the cutter blades 19 a predetermined distance for each complete rotation of the operating rod 24. In the present commercial form of the machine the screw-threads 21 and 28 are each twenty-two per inch and the angle of the face of the conical member of the pilot 20 is 29° to the axis of said pilot.

Obviously by turning the operating rod 24 to project the cutter blades 19 the micrometer thimble 25 will also turn therewith and cause said thimble to move axially on the boring bar 18.

This rotary and axial movement of the micrometer thimble 25 changes its reading on the scale 92 and the reading of the vernier 91 on the reading line 93 thus indicating at all times the diameter at which the cutter blades 19 are set to cut. It will thus be seen that the reading on the micrometer will indicate the exact diameter at which the cutter blades are set to cut.

By loosening the thumb-screw 30, the micrometer thimble 25 may be axially adjusted with respect to the boring bar 18 to correct its reading on the scale 92 and the reading of the vernier 91 on the reading line 93.

In a broad sense the operating rod 24 is a part or extension of the pilot 20.

Before mounting the machine on a cylinder block and centering the same in respect to the cylinder to be rebored, the operator ascertains the part of the cylinder worn to the greatest diameter and then mounts the machine on said block with the cutter head above said block, its cutter blades 19 retracted to a diameter less than that of said cylinder and the key 82 in neutral position. The hand-wheel 86 is now operated to lower the cutter head 16 into the cylinder with its cutter blades 19 positioned for contact with the wall of the cylinder having the greatest diameter and thereafter the operating rod 24 is turned by means of the hand-crank 32 to project the cutter blades 19 and cause their cutting edges to impinge against said wall. This engagement of the cutter blades 19 with the wall of the cylinder causes the machine to shift bodily on the block and thereby automatically center the same. With the machine thus centered the same is rigidly secured to the block by a clamp 84.

The reading of the micrometer is noted to ascertain the diameter at which the cutter blades 19 are set or, in other words, the greatest diameter of the worn cylinder, and thereafter the operating rod 24 turned in a reverse direction to retract the cutter blades 19 to a diameter that will permit the cutter head 16 to be freely lifted from the cylinder. Next the hand-wheel 86 is again operated to project the cutter blades 19 and the micrometer reset at the reading previously noted, thus setting the cutter blades 19 to the same diameter at which they were set in the cylinder. If it is desirable to cut the cylinder to a still larger diameter the operating rod 24 may be further rotated to project the cutter blades 19 the desired number of thousandths of an inch which is indicated on the micrometer. With the cutter blades 19 adjusted for the desired cut the key 82 is shifted to complete the driving connections to the boring bar 18 and cause the same to be moved axially into the cylinder at the desired speed during the rotation thereof.

The electric circuit for the motor 33 includes a snap switch 95 mounted on the housing 12 which has a vertically movable member 96, when raised, closes the circuit and when lowered opens the circuit to stop the motor 33. This switch member 96 is manually operated to start the motor 33 and automatically operated to stop said motor at the completion of each boring operation through a cylinder.

The automatic control for the switch 95 includes a vertically movable stem 97 mounted for endwise sliding movement in bearings 98 on the housing 12 and has on its upper end a segmental head 99, which embraces said housing and holds the stem 97 from turning about its longitudinal axis. A coil spring 100 encircling the stem 97 is compressed between the upper bearing 98 and the head 99 and is under strain to hold the stem 97 raised. Rigidly secured to the stem 97 between the bearings 98 is a radially projecting trip finger 101 which overlies the switch member 96 for operating the same to close the circuit.

Cooperating with the head 99 is a collar 102 on the boring bar 18 and rigidly secured thereto in different vertical positions by a set-screw 103 which extends into the keyway 53 and impinges against said bar. The adjustment of the collar 102 on the boring bar 18 is such as to engage the head 99 at the completion of each boring operation, depress the same and thereby cause the trip finger 101 to engage the movable switch member 96 and move the same downward into a position to close the circuit and stop the motor.

When the boring bar 18 is raised, the collar 101 will be lifted thereby from the head 99 allowing the spring 100 to reset the trip and the switch member 96 will remain in its lowermost position with the circuit closed until said member is manually operated to start the motor. To facilitate the turning of the micrometer thimble 25, the same is knurled, as indicated at 104.

A screw-eye 105, secured in the upper end of the post 62, is provided, as one means, for hold-

ing the boring bar 18 suspended from a hoist by which the boring machine may be swung over an engine block in an automotive vehicle and then lowered onto the block without danger of marring or damaging the vehicle.

What I claim is:

In a portable boring machine, a hollow base adapted to rest upon an engine cylinder block over a cylinder thereof, a housing on the base, an upright tubular boring bar extending through said hollow base and journaled in the housing for compound rotary and axial movements, a cross-head in which the boring bar at its upper end is journalled, bearing means holding the cross-head for axial movement with the boring bar, an upright guide post rigidly secured at its lower end to the housing, a rack on the post, said cross-head having a bearing in which the post is slidably mounted, a pinion journaled on the cross-head and meshing with the rack, an upright drive shaft journaled in a bearing on the housing and held against axial movement therein, a bearing on the cross-head in which the drive shaft is slidably and rotatably mounted, change speed means mounted on the cross-head for operating the pinion from the upright drive shaft to lower the cross-head and boring bar at desired rates of speed, means in the housing for operating the drive shaft from the boring bar, and manually operated means on the cross-head for rotating said pinion independently of the drive shaft to raise or lower the cross-head and boring bar.

THOR THORSEN.