

Jan. 15, 1963

B. HOFFMANN  
BORING MILL

3,073,185

Filed Dec. 21, 1959

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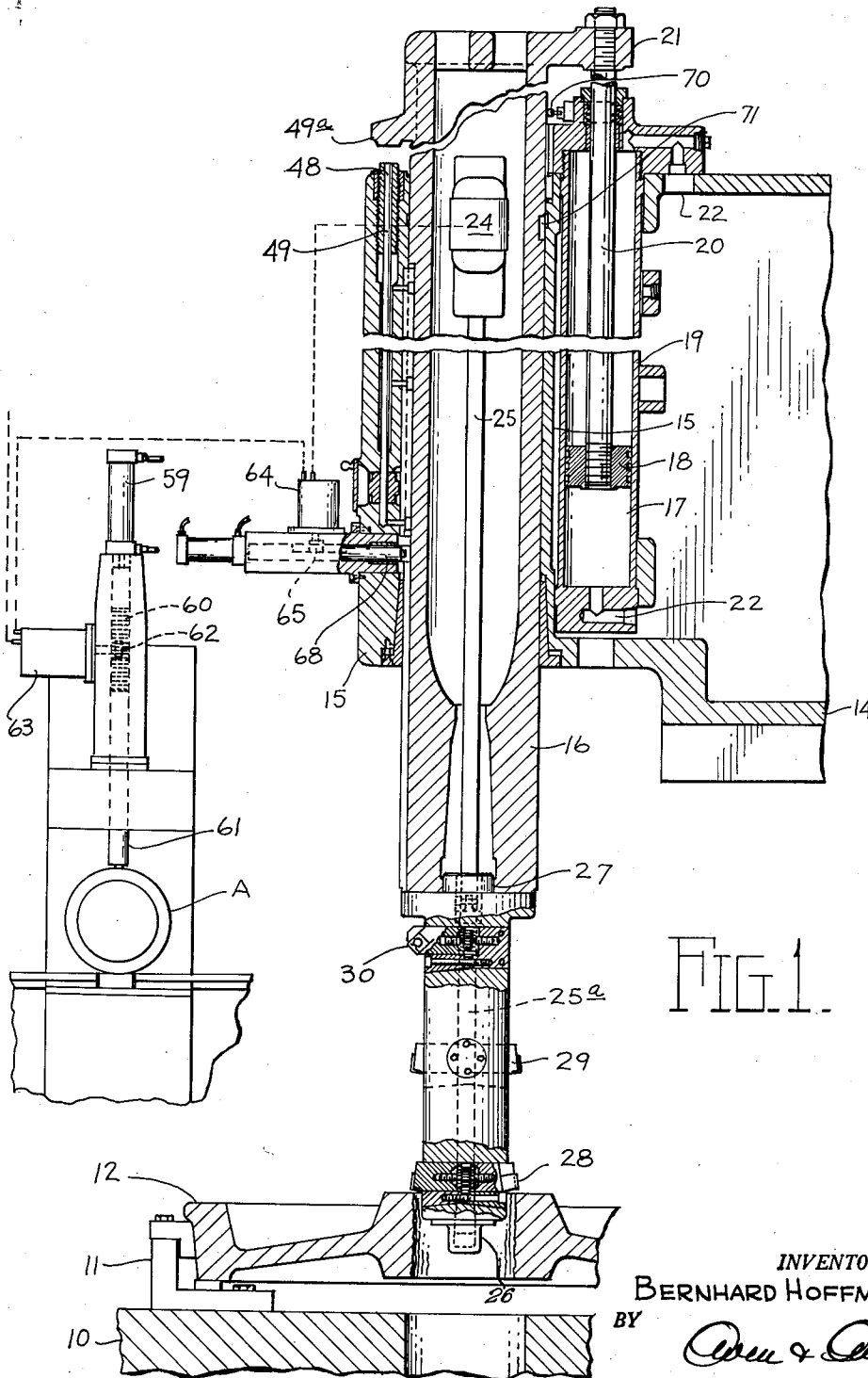


FIG. 1

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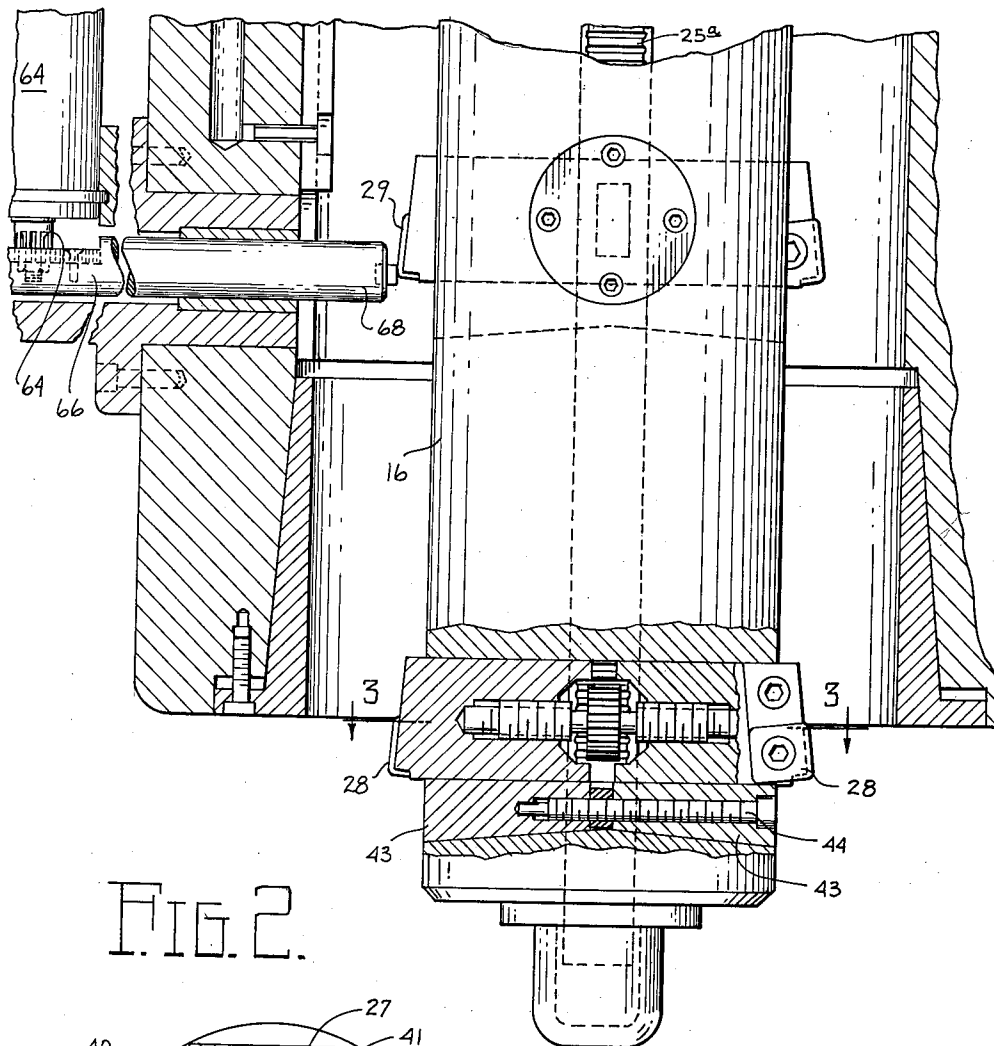


FIG. 2.

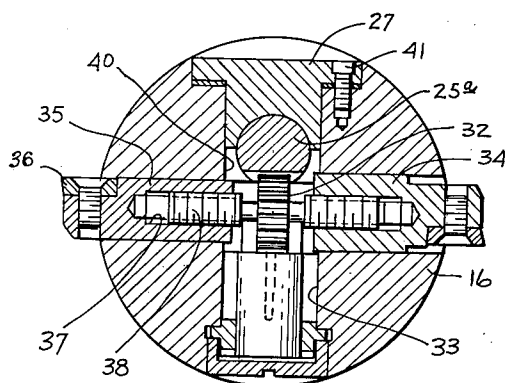


FIG. 3.

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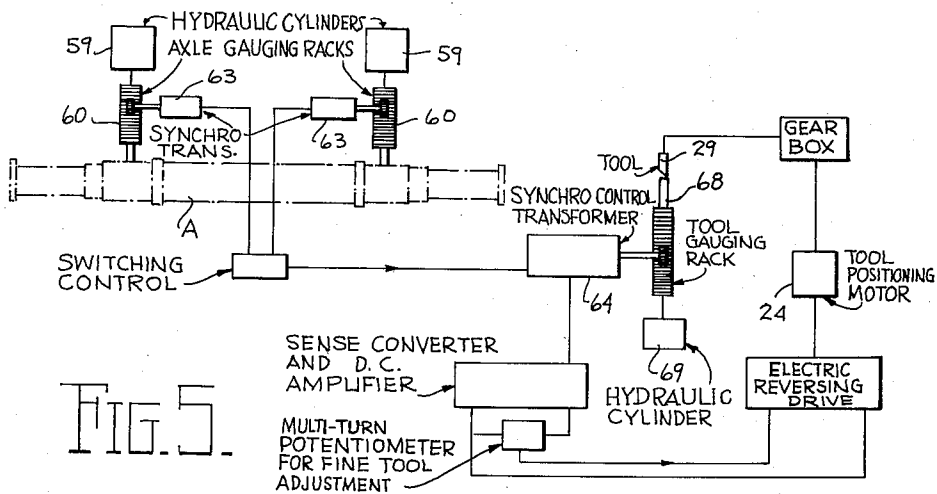
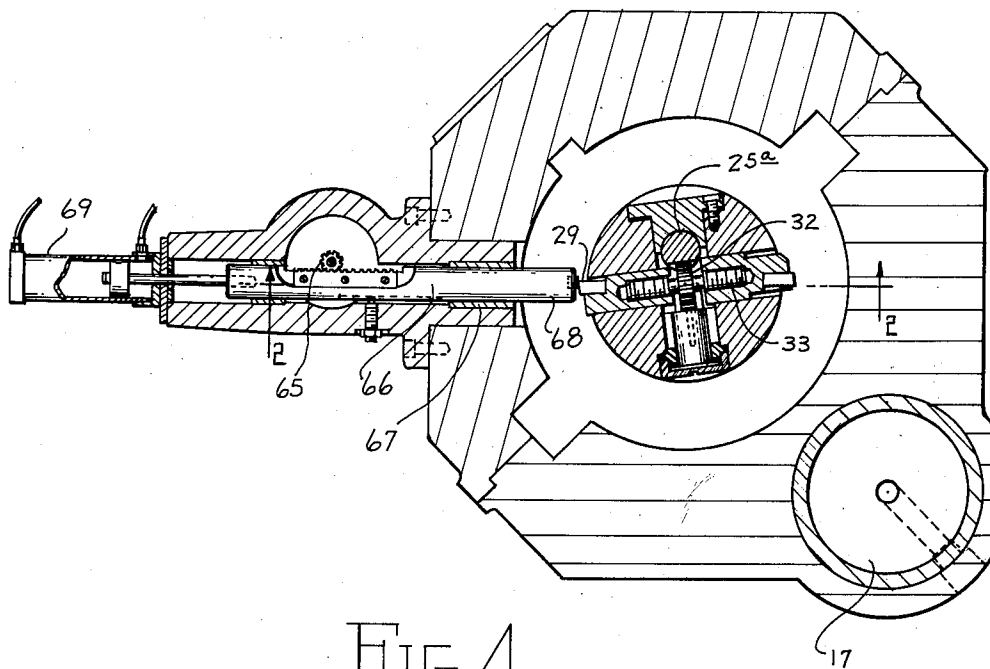
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4 Sheets-Sheet 3



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FIG. 7

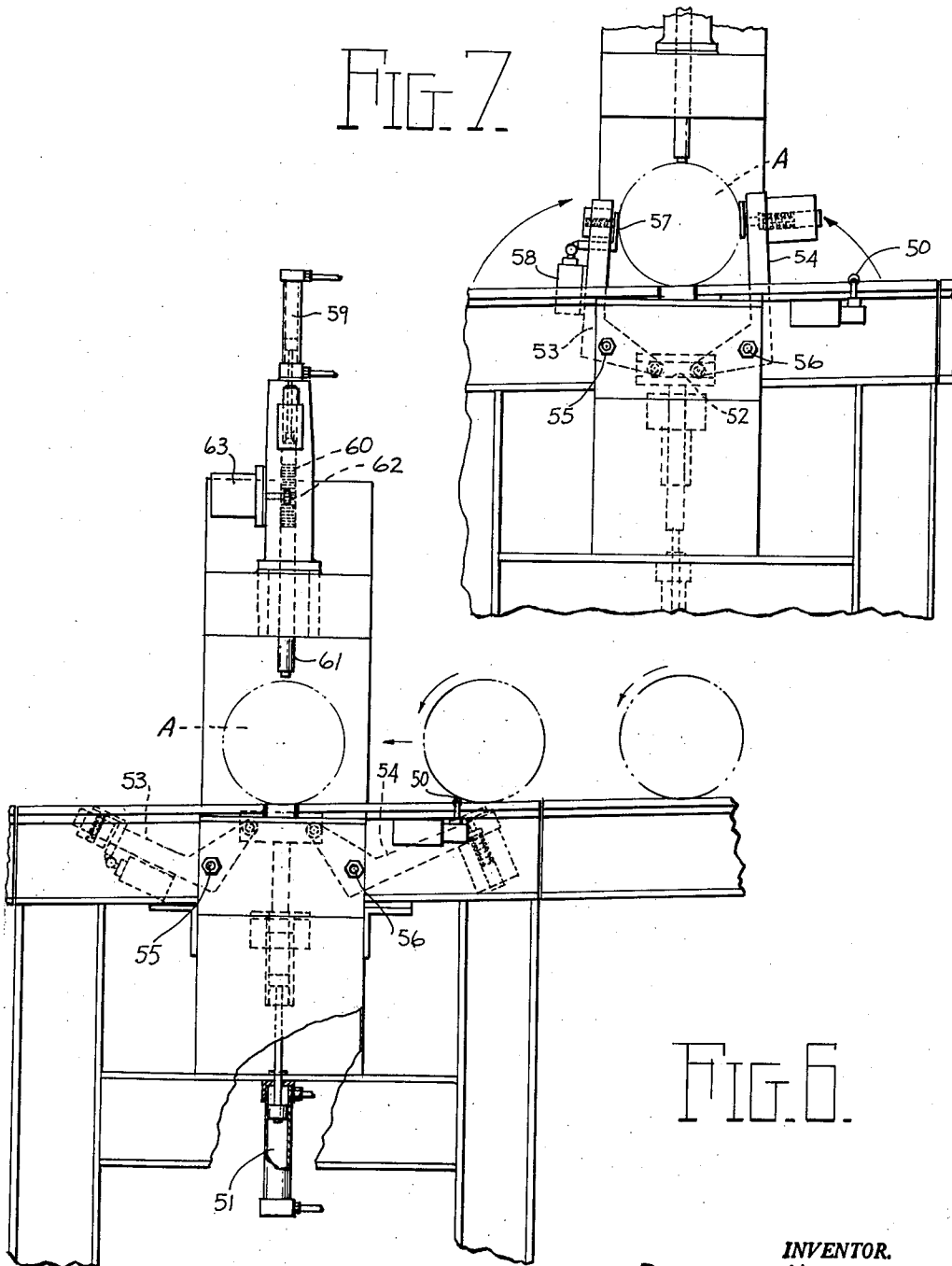


FIG. 6

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## BORING MILL

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3 Claims. (Cl. 77—4)

The present invention relates broadly to boring mills, and, more specifically, to an improvement in a car wheel boring machine which sets the radius of the boring tools automatically.

In present day practice the boring of car wheels, whether they be of cast iron or steel, has been greatly simplified due to the various automatic features that have been incorporated into wheel boring machines of the hydraulic type. These machines have been designed to such a degree of versatility that the car wheel is automatically chucked and then bored by roughing and finishing cutters and chamfered in the same series of operations. Furthermore, during said operations the machine is designed to be fed at different speeds with the speed changes being automatic between the rough cutting, finish cutting, chamfering and tool withdrawal operations. Thus, the operations of such a machine are substantially continuous and automatic, resulting in maximum production, yet requiring a minimum of time and effort on the part of the operator.

At the present time, in finishing car wheels preparatory to mounting them upon axles, it is necessary to measure the diameter of the axle to be fitted with a conventional micrometer and then bore the hub opening in the car wheel to the proper diameter, which is usually slightly less than the diameter of the axle, so that the wheel will have a drive fit on the axle. The practice by the railroads of refinishing car wheels embodies substantially the same operations as employed in finishing new car wheels, in that, the wheel is removed from the axle and the bore of the car wheel is then refinished preparatory to mounting said wheel upon a new or a refinished axle. It is, however, necessary that a skilled machinist measure the diameter of the new axle with a micrometer, adjust the cutters so as to bore a hole the diameter of which shall be slightly less than the diameter of the axle in order to ensure that the wheel will have a proper drive fit when mounted upon said axle.

While the foregoing type of operation has proven to be satisfactory and acceptable, it does require that measurements be taken of one part and manually transferred to another part in setting up the boring mill. While the boring and chamfering operations are automatically performed by the boring mill machine, the measurements necessary for properly positioning the cutting tools depends upon a correct and accurate measurement being obtained by a machinist, which always brings into being the possibility of an error developing that could result in the entire wheel being improperly bored and thus subject to being scrapped.

One of the objects of the present invention is to provide a car wheel boring machine that is automatic in operation for boring the hubs of a car wheel.

Another object is to provide a car wheel boring machine having a boring bar with tools adjustably mounted therein and means for adjusting said tools radially of the boring bar commensurate with the diameter of an axle upon which the car wheel is to be mounted.

Another object is to provide a car wheel boring machine having a vertically reciprocating boring bar with adjustable cutting tools carried thereby and motor means disposed within said boring bar for radially adjusting said cutting tools dependent upon the diameter of an axle upon which the car wheel is to be mounted.

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Other objects and advantages, more or less ancillary to the foregoing, in the manner in which all of the various objects are realized, will appear in the following description which, when considered in connection with the accompanying drawings, sets forth the preferred embodiment of the invention.

Referring to the drawings, wherein the preferred embodiment of the invention is illustrated:

FIG. 1 is a fragmentary vertical sectional view of a car wheel boring machine embodying the present invention incorporating a diagrammatic representation of an axle gauging mechanism associated therewith;

FIG. 2 is an enlarged fragmentary detailed sectional view of the lower portion of the boring bar with the cutting tools disposed therein, the section being taken on line 2—2 of FIG. 4;

FIG. 3 is a cross-sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a horizontal sectional view of the machine with a tool in the gauging position shown in FIG. 2;

FIG. 5 is a schematic diagram showing the interconnection of the gauging devices and the tool adjusting mechanism;

FIG. 6 is a diagrammatic showing with parts in section of an axle gauging station with axle centering wings in position to receive an axle to be gauged; and

FIG. 7 is a fragmentary view of the parts shown in FIG. 6 with the centering wings closed about an axle, and the gauging feeler in its sensing position.

Referring to FIG. 1, there is shown a table 10 that is rotatably mounted upon a bed of a conventional boring machine, such as the type disclosed in Patent 2,619,854 of December 2, 1952, to Schurr. The rotatable table 10 has mounted, on the upper face thereof, a plurality of spaced chuck jaws 11 that are slidably supported upon suitable guide members, not shown, which extend radially of the table 10. The chuck jaws 11 are adapted to engage and retain a car wheel 12 in proper position to have work operations performed thereon by suitable boring bars.

A frame 14 is adapted to be supported by the bed of the boring machine and it, in turn, carries a cylindrical guide 15 in which is mounted a vertical boring bar 16. The frame 14 also has mounted thereon a hydraulic motor which is adapted to operate the boring bar 16 in a vertical reciprocatory manner within the guide 15. The hydraulic motor 17 consists of a piston 18 operating within a cylinder 19 and having a connecting rod 20 mounted thereon which is turn connects the piston with the boring bar 16 through the connecting member 21. The hydraulic motor 17 is provided with inlet and outlet connections 22 at each end thereof, which are adapted to be connected to a suitable hydraulic pump, not shown, for the delivery of fluid under pressure to cause reciprocation of the piston 18 within the cylinder 19 and the resultant movement of the boring bar 16. Such mechanism is conventional in the art.

The hollow boring bar 16 has mounted in the upper portion thereof, in any suitable manner, a reversible motor 24. The reversible driving motor 24 has a conventional nut drive which engages a splined screw (not shown) to cause a reciprocation of a shaft member 25. The direction of reciprocation of the shaft member depends on the direction of rotation of the motor 24. The reciprocating shaft member 25 carries or is drivingly connected with a rack member 25a which extends substantially the entire length of the boring bar 16 with the lower end of the rack member projecting at an extreme of its movement into a suitable cap or housing 26 provided on the bottom or lower face of the boring bar. The rack member 25a is supported by suitable bearing members 27 provided at spaced points within the lower end of the boring bar 16 to

insure its proper alignment within the boring bar and its engagement with the driving means of the motor 24.

The boring bar 16 is provided with three cutting tools, with the lowermost tool 28 being a rough boring tool, while a finishing boring tool 29 is disposed midway between the rough boring tool 28 and a chamfering tool 30. The three tools are radially adjustable within the boring bar 16. In the form of adjustment shown in the drawings, each of the tools has associated therewith a spur pinion which is adapted to engage the rack member 25a so that upon reciprocatory movement of the rack member, the spur pinions 32 will be rotated to either advance or retract the tools radially of the boring bar. The three cutting tools carried by the boring bar 16 are mounted therein for adjustment in the same identical manner; thus, a description with respect to one of the tools will readily apply to the others.

As shown in FIGS. 2 and 3, the boring bar 16 is provided with a diametrically extending passageway or hole 33 which opens out through the opposite sides of the boring bar. The passageway 33 has slidably mounted therein a pair of tool carriers 34 and 35 which have their outer ends formed to receive the desired replaceable cutting tools 36. Each tool carrier is provided with an internally threaded socket 37 which extends from its inner end short of its outer end, and when the tool carriers are mounted in longitudinal alignment for placement in the passageway 33, the same are connected by a double ended adjustable screw member 38. One end of the screw member 38 is provided with left-hand threads and the other end of the screw member is provided with right-hand threads, and the screw member is threaded into the threaded sockets 37 formed in the carriers 34 and 35.

The central portion of the screw member 38, FIG. 3, has the above-mentioned spur pinion 32 mounted thereon for engagement with the rack member 25a, so that upon reciprocatory movement of the rack member 25a the spur pinion 32 will be rotated in a complementary direction which in turn will rotate the screw member 38 causing the tool holders 34 and 35 to be either retracted or advanced radially of the boring bar 16 depending on the direction of movement of the rack 25a. By providing threads of appropriate pitch on the screw member 38 and socket 37, the cutting members are capable of being radially advanced or retracted to a degree complementary to the degree of reciprocatory movement of the rack member and the rotative movement of the spur pinion 32.

The boring bar 16 is provided with a passage 40, FIG. 3, that is transverse of the passageway 33 and adapted to intersect said passageway so that the bearing members 27 may be mounted within the boring bar 16 and retained therein by cap screws 41 to insure the retention of the rack member in engagement with the spur pinion 32. As shown in FIG. 2, the tool holders 34 and 35 are retained in the passageway 33 by means of adjustable wedges 43 which are held in engagement with one another by a screw member 44, so that said wedges 43 will insure the retention of the tool carriers within the passageway 33 of the boring bar 16, yet still permit the tool carriers to have a radially adjusting movement within the cutting bar upon the rotative movement of the screw member 38. The removal of the screw member 44 enables the wedges 43 to be withdrawn, thereby permitting the tool carriers 34 and 35 to be removed from the boring bar as a unit so that the tool carriers can be replaced.

The present invention is particularly directed to the combination of elements which causes an adjusting actuation of the tool adjusting motor 24 by means of which the radial positions of both the roughing tools 28 and the finish tools 29 are set to the proper dimension. As previously noted, the size of the bore finished by these tools is determined by automatically gauging an axle on which the bored wheel is to be driven. An axle to be fitted with a wheel is indicated generally at A in FIGURE 1 and in FIGURE 6. The axle includes the usual bearing area,

dust guard and wheel seat at each end. Since the present invention is concerned only with a machine which will automatically bore a set of wheels to fit the wheel seat of a given axle, no detailed disclosure of the axle itself need be made.

The axle A is received on a measuring fixture in any suitable manner, and the sequence of operations herein-after described starts at this point. Referring to FIGS. 6 and 7, the axle A is permitted to roll down an incline to a point where it overrides an actuating switch 50 which controls, in any suitable manner, the hydraulic circuit to a wing actuating cylinder 51. The piston within the cylinder 51 is moved downwardly by the hydraulic force of the cylinder and causes a slide 52 to move downwardly. The slide has pivoted thereto a pair of axle engaging wings 53 and 54 in the form of bell crank levers pivoted to a stationary portion of the mechanism at 55 and 56 respectively. Thus, as soon as the axle A passes the actuating switch 50, the wings commence to move in and to clamp the axle in the centered position shown in FIG. 7.

As can be seen in FIG. 7, the axle engaging wing 53 carries a small pin 57 which engages the axle when the wing is in its fully closed position. This pin is forced to the left by engagement with the axle and closes an actuating switch 58 which starts the tool gauging mechanism in operation.

Closing the switch 58 actuates the hydraulic circuit of a cylinder 59 connected to an axle gauging rack 60. The rack is attached directly or indirectly to the piston which is within the cylinder 59, and the rack carries at its nose portion a feeler member 61 which engages the wheel seat of the axle as shown in FIGS. 1 and 6.

Meshed with the rack 60 is a pinion gear 62 which is carried by the shaft of a synchro transmitter 63 so that the armature of the transmitter is rotated as the rack moves in towards the axle, and the extent of its rotation will be determined by the extent of the movement necessary for the feeler 61 to engage the wheel seat of the axle.

A synchro follower 64 is electrically connected to the transmitter 63 and, of course, follows its movements so that the angular movement of the follower is precisely the same as the angular movement of the transmitter.

As will be seen from FIG. 4, the follower 64 carries a pinion 65 which is in meshing engagement with a follower rack 66. This assembly is carried by the boring bar housing and projects through the side wall thereof in a suitable bearing 67. The follower rack 66 has a tool engaging feeler 68 on its inner end so located as to engage the cutting edge of the finishing tool 29 as best shown in FIG. 2. The rack 66 is moved inwardly by a hydraulic cylinder 69 to the point where the feeler 68 engages the tool.

It should be assumed that the resetting of the tools starts with the tools in their innermost position each time the boring bar is brought to the top of its stroke after the completion of a wheel. The axial position of the finishing tool is such that it coincides with the position of the feeler 68 when the boring bar is completely withdrawn into its housing. The tool adjustment motor 24 is energized to bring the finishing tool 29 to the radially outward position in which contact with the feeler 68 is made after which the motor continues to operate so long as an imbalance exists between the angular position of the sensing synchro 63 and the follower synchro 64. The unbalancing signal is suitably amplified and fed to the motor 24 as an operating voltage in a known manner. The outward movement of the tool against the feeler 68 takes place against the pressure of the fluid in cylinder 69, and this movement corrects the position of the follower synchro 64 by actuating pinion 65 through rack 66. The motor 24 continues to move the tool out against the feeler until the two synchros are balanced, which condition occurs only when the radial position of the finishing tool is such that it will bore a hole in a car

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wheel of the proper diameter to receive an axle of the size that is then engaged by the feeler of the synchro transmitter 63.

Obviously, movement of the rack 25a to adjust the finishing tool 29 to the proper radial position simultaneously causes a radial adjusting movement of the roughing tool 28 and the chamfering tool 30. The tools are then in an adjusted position and the roughing and finish cut of a wheel blank placed on the machine will exactly coincide with the dimension established by the feeler 68 which, in turn, coincides with the dimension of the axle A established by the gauging tool feeler member 61.

The boring tools having been properly positioned radially by the action of the motor 24 through the rack mechanism 25a described above, a car wheel 12 is placed upon the chuck jaws 11 mounted on the rotatable machine table 10, and the vertical boring bar 16 is moved downwardly in a conventional manner to bring first the rough boring tool 28 into engagement with the car wheel. After the rough boring operation, the finishing tool 29 is brought into position and the bore finished. As above noted, the action of the boring bar is conventional and is caused by piston 18 moving downwardly within cylinder 19. When the finishing tool 29 has passed through the bore of the wheel hub, the chamfering tools 30 are subsequently brought into engagement with the edge of the car wheel hub to impart a chamfer to the hole which has been previously machined by the rough and finished boring tools. The downward movement or stroke of the boring bar 16 and the degree or depth of cut of the chamfering tool 30 is determined by an adjustable stop rod 48 carried in the boring bar guide 15. The stop rod 48 is provided with an adjustable mechanism 49 for positioning the upper end of the stop rod to engage an outwardly projecting abutment formed on or carried by the upper end portion of the hollow boring bar 16. Thus, with the stop rod outwardly positioned by the adjusting mechanism 49, the abutment 49a on the hollow boring bar 16 will engage the upper end of the rod 48 thus stopping the movement of the boring bar and of the chamfering tool 30. The stopping of the downward movement of the boring bar causes the hydraulic motor 17 to be reversed so that the piston 18 will be moved upwardly. This reversal of movement at the end of the machine operation is conventional. In the case of the present invention, the upward movement of the boring bar is accompanied by an inward movement of the tools, so that by the time the boring bar has reversed to the point that the finishing tool would pass through the hole that has been previously bored, the tools have been retracted by energizing the motor 24 and the finishing and roughing tools can both pass through the bored hub so that the hub will not be scored as sometimes occurs with conventional machines.

The upward movement of the boring bar and the inward movement of the tools continue until a limit switch 70, which can take any suitable form, is actuated by some such means as a depression 71 in the boring bar body. When the limit switch drops into the depression the upward movement of the boring bar is stopped and the parts are ready for a new setting. The limit switch 70 is wired to act as an interlock, in any suitable manner, so that no energy can pass into or out of the synchros, and no adjusting movement of the racks 60 and 66 can be made until the boring bar is in such a position that the finishing tool 29 is opposite the feeler 68.

FIG. 5 indicates diagrammatically a system in which two wheel seats are gauged consecutively so that a pair of wheels will be produced for the axle A. It may be desirable, in some instances, to use a single axle gauging mechanism and to transport this mechanism from one wheel seat to the other. If desired, however, duplicate axle gauging devices can be provided and con-

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nected to an appropriate switching mechanism so that one or the other will close the circuit to the follower synchro 64 and its associated rack 66.

No attempt has been made in the present specification to show the exact electrical circuits or hydraulic circuit involved since these are well known in the art. While various of the elements are shown diagrammatically, various modifications and changes will suggest themselves to those skilled in the art, and such modifications may be made without departing from the scope of the appended claims.

What I claim is:

1. In a boring mill having a rotatable table for supporting a car wheel or the like, a hollow boring bar positioned in a plane transverse to said table for engagement with said car wheel, motor means associated with said boring bar for advancing and retracting said boring bar with respect to said car wheel, means for providing relative rotatable movement between said boring bar and the car wheel, a plurality of tools slidably mounted for radial adjustment in said boring bar, means mounted in said boring bar for reciprocatory movement therein and engageable with said tools for radially advancing and retracting said tools with respect to said boring bar, means connected to said reciprocatory means for driving said reciprocatory means, feeler means, means for lineally moving said feeler means into contact with an axle on which the car wheel is to be mounted, centering means for positioning the axle centrally in the path of said feeler means, switch means actuated by said centering means when the axle is centered to actuate said feeler moving means to move said feeler means into contact with the axle, and means responsive to said feeler means for energizing said drive means to advance said tools radially to a position such that the diameter of a hole drilled thereby in the car wheel bears a predetermined relationship to a diameter of the axle.

2. In a boring mill having a frame and a rotatable table for supporting a car wheel or the like, a guide carried by said frame, a hollow boring bar mounted in said guide for reciprocatory movement into and out of engagement with said car wheel, a hydraulic motor mounted on said frame and engageable with said boring bar for actuating same, a reciprocatory rack member mounted in said boring bar, a motor in said boring bar, driving means carried by said motor and engageable with said rack member, said boring bar having an opening there-through, a pair of radially disposed spaced cutters slidably mounted in said opening and provided with opposed axially aligned internally right and left hand threaded bores, a spur pinion mounted in said opening between said cutters and having right and left hand threaded extensions on opposite sides thereof engaging the threads in said bores, said rack member engaging said spur pinion for radially advancing and retracting said cutters with respect to said boring bar upon the movement of said rack member, means including a synchro transmitter to sense the diameter of an axle to which a wheel is to be fitted, a synchro follower actuated means to gauge the radial position of one of said tools to bore a wheel to a diameter established by said synchro transmitter, and connecting means between said motor and said synchro follower to advance said tools radially of said boring bar to the position established by said synchro transmitter.

3. In a boring mill having a rotatable table for supporting a car wheel or the like, a hollow boring bar positioned in a plane transverse to said table for engagement with said car wheel, means associated with said boring bar for advancing and retracting said boring bar with respect to said car wheel, a plurality of tools slidably mounted for radial adjustment in said boring bar, means reciprocally mounted in said boring bar and engageable with said tools for advancing and retracting said tools radially of the boring bar, a motor mounted in

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said boring bar, driving means carried by said motor and engageable with said reciprocally-mounted means, first feeler means adjustable to a diameter of an axle to which a wheel is to be fitted, first responsive means responsive to the position of said feeler means, second feeler means, means for moving said second feeler means into contact with one of said tools, second responsive means responsive to the position of said second feeler means and co-operating with said first responsive means to gauge the radial position of said one tool to bore a wheel to a diameter established by said first responsive means, and connecting means between said motor and said second responsive means to advance said tools radially of said boring bar to the position established by said first responsive means.

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