May 8, 1934. A. STORM ET AL 1,958,075

MEANS FOR ADJUSTING THE CUTTERS OF BORING MACHINES AND THE LIKE

Filed Nov. 27, 1931

Fig. 1

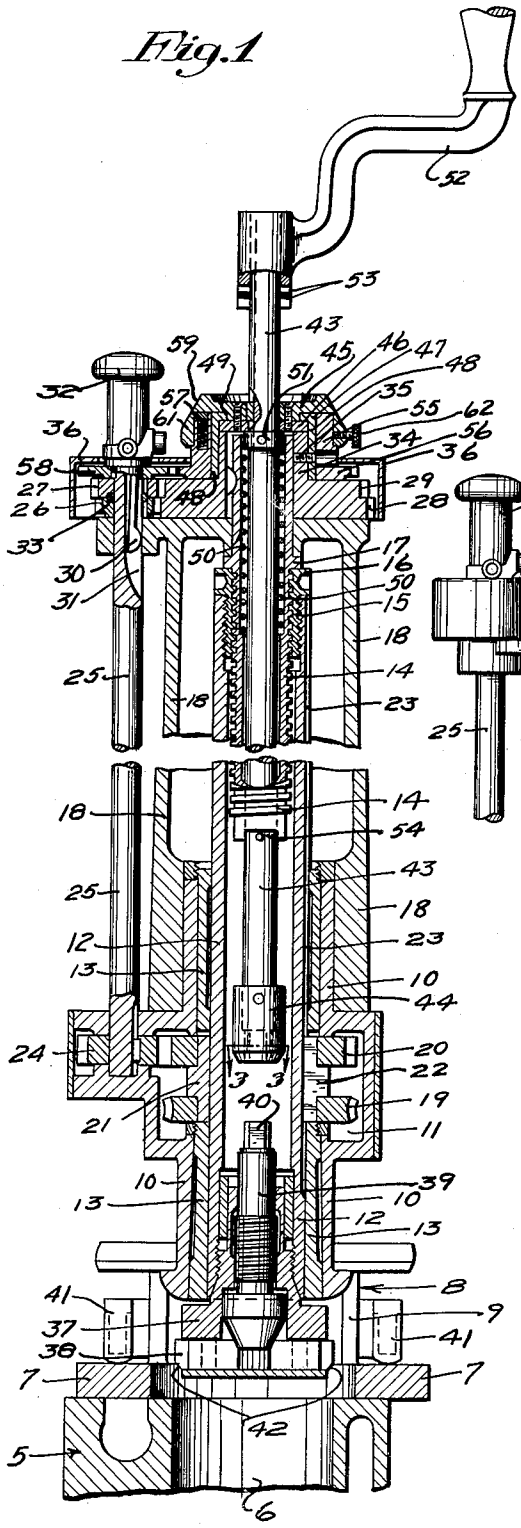


Fig. 2

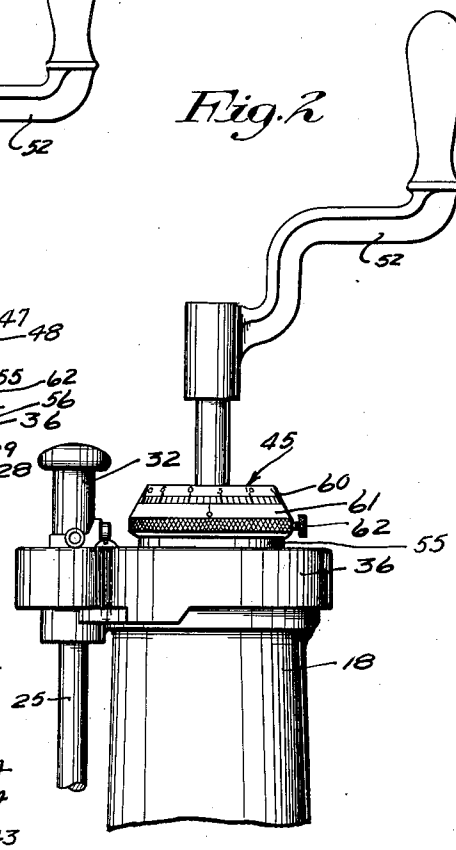
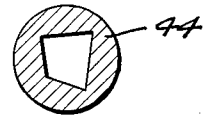


Fig. 3



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MEANS FOR ADJUSTING THE CUTTERS OF BORING MACHINES AND THE LIKE

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Application November 27, 1931, Serial No. 577,476

16 Claims. (Cl. 77—2)

This invention relates to boring machines and the like and has for its object the provision of highly efficient means for adjusting the cutters thereof from the exterior of the machine without disturbing or changing the mounting of the machine on an engine block or the centering thereof in respect to one of its cylinders. Heretofore, it has been necessary when re-boring the cylinders in an engine block to remove the machine from the block and the cutter head from the machine in order to adjust the cutters and thereafter re-center the machine and secure the same to the block for each cut to be made through one of the cylinders.

Our present invention is in the nature of a modification or extension of the invention disclosed and broadly claimed in our copending application of the same title filed November 27, 1931 under Serial Number 577,475.

The cutter adjusting means, in the above identified application, due to its simplicity, is moved during the boring operation in a manner which changes the reading of the indicator with a result that each time a cut is made through a cylinder, it is necessary to adjust the cutters to the walls of the cylinder, reset the indicator or take the reading thereof, operate the machine to lift the cutters from the cylinder and adjust the same by the indicator for a predetermined cut.

In the present application automatic means is provided for keeping the indicator in its set position during the boring operation of the machine, whereby it is possible to adjust the cutters from the exterior of the machine, for successive cuts to be made therethrough, without resetting the cutters in respect to the wall of the cylinder after each cut, and the indicator will show the total number of thousandths cut during the re-boring of a cylinder.

The invention, as illustrated, is embodied in a boring bar of the type disclosed and broadly claimed in the pending application of Adolph Storm "Boring machine" filed September 14, 1929, under Serial Number 392,649.

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

In the acompanying drawing, which illustrates the invention, like characters indicate like parts throughout the several views.

Referring to the drawing:

Fig. 1 is a fragmentary view principally in central vertical section illustrating a boring machine having the invention embodied therein;

Fig. 2 is a fragmentary side elevation of the upper portion of the parts shown in Fig. 1; and

Fig. 3 is a detail view in section taken on the line 3—3 of Fig. 1, on an enlarged scale.

A fragment of an engine cylinder block is illustrated in the drawing and indicated as an entirety by the numeral 5 with the exception of its cylinders 6, only one of which is shown, and on which block the boring machine, in which the invention is embodied, is mounted.

The boring machine illustrated has an annular base 7 which rests directly on the top of the engine block 5 and supports said machine perpendicular thereto. Said base 7 is provided with a raised cylindrical central portion 8 provided with a plurality of circumferentially spaced sight openings 9. Integral with the base portion 8 is a cylindrical main housing 10 that is circumferentially expanded, intermediate of its ends, to afford a gear compartment 11.

A boring bar 12 is turnably mounted in two bearings 13 in the housing 10, one of which is below the gear compartment 11 and the other of which is above the same.

Extending axially into the boring bar 12, from the top thereof, is a tubular feed screw 14 to which a nut-acting member 15 is applied for rotating the same. This nut-acting member 15 is secured in the upper end of the boring bar 12 by screw-threads and provided with an expanded annular head 16 which engages the upper end of the boring bar 12 as a stop and limits the turning movement of said member into the boring bar 12 and holds the same against the turning action of the feed screw 14 therein. Formed in the head 16 are circumferentially spaced seats for a tool designed to screw the nut-acting member 15 into the boring bar 12 or remove the same therefrom.

The feed screw 14 is provided, intermediate of its ends, with a fixed collar 17 and above said collar with an unthreaded portion that is journaled in a bearing therefore in the closed top of a cylindrical auxiliary housing 18, the lower end portion of which is telescoped onto the upper portion of the main housing 10 with a tight fit, which holds the same from turning about the axis thereof, and supported on the top of the compartment 11. The collar 17 on the feed screw 14 engages a boss on the under side of the top of the auxiliary housing 18 and prevents lifting movement of said feed screw in its bearing in the top of the auxiliary housing 17 and which collar also affords a stop to limit the retracting or lifting movement of the boring bar 12.

Within the gear compartment 11 is a worm

gear 19 and a spur gear 20 mounted on a hub 21 with the former below the latter. These gears 19 and 20 are secured by a key 22 to the hub 21 for rotation therewith and which hub is mounted on the boring bar 12 with freedom to permit axial movement of said bar therethrough. The key 22 also extends into a long key-way 23 in the boring bar 12 and secures said bar to the hub 21 for rotation therewith but at the same time permits the required axial movement of the boring bar 12 therethrough. Opposing bosses on the top and bottom of the gear compartment 11 are engaged by the gears 19 and 20 and hold the hub 21, and hence, said gears against axial movement in said housing.

The boring bar 12 is rotated by an electric motor and connections, not shown, except the worm gear 19, which forms a part of said connections. During rotation of the boring bar 12, endwise feeding movement is imparted thereto, under the action of the feed screw 14, by the following connections including the spur gear 20 with which a spur pinion 24 meshes. This spur pinion 24 is keyed to the lower end of an upright shaft 25 journaled at its lower end portion in bearings in the top and bottom of the gear compartment 11 outward of the auxiliary housing 17. The upper end portion of the shaft 25 is journaled in a bearing on the top of the auxiliary housing 17. The shaft 25 is connected to the feed screw 14 by a variable speed transmission mechanism which includes a pair of differential spur pinions 26 and 27 loosely journaled on said shaft for independent rotation and mesh, respectively, with a pair of differential spur gears 28 and 29 keyed to the feed screw 14.

A sliding key 30 is mounted in a key-way 31 in the shaft 25 for movement from neutral to a position in which it connects either one of the pinions 26 and 27 to the shaft 25. This key 30 is formed on the lower end of a long body, which is atttached to a key shift hand-piece 32 slidably mounted on the upper end of the shaft 25. A cam-acting collar 33 on the shaft 25 between the pinions 26 and 27 is provided to cam the key 30 out of the key-ways in the pinions 26 and 27 during endwise movement of said key.

The pinions 26 and 27 and the gears 28 and 29 are supported on the top of the auxiliary housing 17 and the hub 34 of the gears 28 and 29 is extended thereabove and rigidly secured to the feed screw 14 by a set-screw 35, which holds said feed screw suspended in the boring bar 12.

Obviously, the ratio of the pinion 26 and gear 28 is such as to turn the feed screw 14 at a relatively slow speed and the ratio of the pinion 27 and gear 29 is such as to turn said feed screw at a relatively fast speed.

A casing 36 for the pinions 26 and 27 and the gears 28 and 29 is supported from the auxiliary housing 17 and the hand-piece 32 is thereabove as well as the upper end portion of the hub 34.

A cutter head 37 is mounted on the lower end of the boring bar 12 and detachably secured thereto by screw-threads. This cutter head 37 is provided with a plurality of radially adjustable cutters 38 and a pilot 39 for simultaneously adjusting said cutters. Said pilot 39 has screw-threaded engagement with the cutter head 37, extends axially into the boring bar 12 above the cutter head 37 and has on its upper end a coupling head 40, that is a trapezium in cross section.

A clamp, indicated as an entirety by the numeral 41, is provided for rigidly securing the machine to the engine block 5 with the cutter head 37 centered in respect to one of its cylinders. For the purpose of this case, it is not thought necessary to further describe or illustrate the clamp 41 or the centering of the cutter head 37 except to note that the lower outer edges of the cutters 38 are beveled at 42.

To center the machine the cutters 37 are adjusted so that their beveled surfaces 42 rest on the upper edge of the cylinder 6 and thereafter the boring bar 12 adjusted to lift the machine and position its base 7 just out of contact with the block 5. With the machine thus supported by its cutter 37, their beveled surfaces 42 will automatically move the machine laterally and center its cutter head 37 in respect to the cylinder 6.

As previously stated, it has heretofore been necessary to re-center the machine each time a cut was to be made through a cylinder, which required the removal of the machine from the block and the removal of the cutter head from the boring bar in order to adjust its cutters.

It may be here stated that at the completion of a boring operation, the motor-driven connections to the worm gear 19 are reversed and the machine operated to retract the boring bar 12. As this reversing of the boring bar 12 is fully shown and described in the Storm application Serial Number 392,649, it is not thought necessary to show or describe the same in the present application.

The parts thus far described are substantially identical with corresponding parts of the application heretofore identified with the exception that in the present application the feed screw is tubular, the pilot for the cutter head has a novel coupling head and certain other minor details.

Referring now in detail to the invention which permits the cutters 38 to be adjusted for different cuts without disturbing the machine after the same is once secured to an engine block and its cutter head centered in respect to one of its cylinders.

Extending axially into the tubular feed screw 14, from the upper end thereof, is a shaft 43 having on its lower end a socketed coupling member 44 adapted to be inserted over the pilot coupling head 40 by an endwise projecting movement of said shaft to connect the pilot 39 for rotation therewith. The socket in the coupling member 44 has the same cross section as the coupling head 40 so as to interlock therewith in only one predetermined rotated position of the shaft 43 in respect to the cutter head 37.

A driven clutch member 45 is keyed to the shaft 43 for rotation therewith but with freedom to permit axial movement of said shaft therethrough. This clutch member 45 is provided with a depending two-part hub 46, the sections of which are rigidly but detachably connected by screws and which hub rests on the upper end of the hub 34 and supports the clutch member 45 therefrom. A separable connection is provided for holding the clutch member 45 against axial movement from the hub 34 but with freedom for rotation in respect thereto and comprises an annular internal tongue 47 on the upper end of a sleeve bearing 48, and an annular groove 49 in the two-part hub 46. The sleeve bearing 48 is telescoped onto the hub 34 and rigidly secured thereto by the screw 35.

Encircling the shaft 43 is a coiled spring 50 compressed between an internal shoulder on the feed screw 14 and a collar 51 fixed to the shaft

43 below the hub 46, and which spring normally holds the shaft 43 raised or retracted with the collar 51 engaging the hub 46 as a stop to limit the lifting movement of the shaft 43.

A hand-crank 52 for turning the shaft 43 is applied to the upper end thereof and detachably secured thereto by a separable connection 53 comprising a transverse pin and diametrically opposite notches. A clutch 54 is provided for connecting the shaft 43 to the feed screw 14, when said shaft is held raised by the spring 50, whereby said feed screw may be manually turned by manipulating the hand-crank 52 to raise or lower the boring bar 12. This clutch 54 comprises a transverse pin in the shaft 43 and a pair of diametrically opposite notches in the lower end of the feed screw 14. When the shaft 43 is depressed to connect the coupling members 40 and 44 and the hand-crank 52 manipulated to turn the pilot 39 for adjusting the cutters 37, the clutch 54 is separated, and hence, the feed screw 14 remains idle during the adjustment of the cutters 37.

Cooperating with the driven clutch member 45 is an annular driving clutch member 55 formed on the hub of a spur gear 56 turnably mounted on the sleeve bearing 48. Said clutch member 55 and the spur gear 56 are held against axial movement on the bearing 48 by the gear 29 and the clutch member 45. A spring-pressed friction clutch member 57 of rubber, felt or like material, is mounted in a seat in the periphery of the clutch member 55, bears against the under face of the clutch member 45 and connects the two clutch members for common movement. The driving clutch member 55 is driven from the shaft 25 by a spur gear 58 keyed to said shaft and meshing with the gear 56.

It is important to note that the gears 20 and 24 have the same ratio as the gears 56 and 58 and thereby turn the clutch member 55 at the same speed as the boring bar 12. The friction clutch member 57 drives the clutch member 45 from the clutch member 55 at the same speed and permits the clutch member 45 to slip thereon for circumferential adjustment in respect to the clutch member 57.

Formed with the clutch member 45 is a beveled peripheral dial 59 graduated to represent thousandths of an inch and cooperating with these graduations is a pointer or zero point 60 on a collar 61. This collar 61 is turnably mounted on the clutch member 55, supported on a shoulder formed at the junction of the hub of the gear 56 and the clutch member 55, and releasably held by a set-screw 62 in different circumferential adjustments on said clutch member. Obviously, the dial 59 may be circumferentially adjusted in respect to the zero point 60 by slipping the clutch member 45 on the clutch member 55 or said zero point may be circumferentially adjusted in respect to the dial 59 by turning the collar 61 on the clutch member 55.

Operation

It may be assumed that the machine is clamped onto an engine block and centered in respect to one of its cylinders with the boring bar retracted and the cutter head 37 positioned above said block with its cutters 38 retracted to a diameter less than that of said cylinder and the key 30 in neutral position.

To make a cut through the cylinder, the handpiece 32 is operated to project the cutter head 37 and position its cutters 38 within the cylinder at the top thereof. The rotation of the shaft 43 by the hand-crank 52 rotates the feed screw 14, which is connected thereto by the clutch 54, and the nut-acting member 15, which is held against rotation, moves said feed screw axially therein and projects the boring bar 12. At this time the gears 28 and 29, turning with the feed screw 14, rotate the pinions 26 and 27, which are loose on the shaft 25 and the clutch member 45, which is keyed to the shaft 43, turns in respect to the clutch member 55, which is held from turning by the gears 56 and 58.

After the cutters 38 are positioned in the cylinder 6, the shaft 43 is projected, by compressing the spring 50, to connect said shaft to the pilot 39 by means of the coupling members 40 and 44. The meshing of the coupling members 40 and 44 can only take place in a predetermined rotated position of the member 40 in respect to the member 44 due to their peculiar transverse contour. While the shaft 43 is connected to the pilot 39, the same is turned by the hand-crank 52 to operate said pilot and project the cutters 38 against the wall of the cylinder and thereafter, while the shaft 43 is held depressed with the cutters 38 contacting with the wall of the cylinder, the collar 61 is adjusted on the clutch member 55 to position its zero point coincident with the zero point on the dial 59.

Endwise pressure on the shaft 43 is next released to permit the compressed spring 50 to lift the shaft 43 and separate the coupling members 40 and 44 and set the clutch 54. The hand-crank 52 is then operated to turn the shaft 43 and the connected feed screw 14 in the proper direction to retract the boring bar 12 and lift the cutter head 37 from the cylinder 6. This rotation of the shaft 43 to retract the boring bar 12 moves the dial 59 out of registration with the zero point 60 so that after the boring bar 12 is retracted the shaft 43 is turned to bring the zero point on the dial 59 into registration with the zero point 60. This resetting of the indicator automatically positions the coupling member 44 to mesh with the coupling member 40 by a downward movement of the shaft 43.

The shaft 43 is now again depressed to move the coupling member 44 into mesh with the coupling member 40 and the hand-crank 52 operated to move the pilot 39 and adjust the cutters 38 for the first cut to be made through the cylinder. This operation of the shaft 43 to project the cutters 38 will turn the dial 59 in respect to the zero point 60 and if a cut of say three one-thousandths of an inch is to be made by the cutters, the turning movement of said dial will be stopped when the reading thereon is coincident with the zero point 60. After the cutters 38 are properly adjusted for the desired predetermined cut, the shaft 43 is released and returned by the spring 50 to normal position, the hand-crank 52 operated to move the key 30 into the spur pinion 26 and the driving connections to the worm gear 19 completed to operate the boring bar 12 at boring speed. At the completion of this boring operation, the hand-piece 32 is operated to move the key 30 into the spur pinion 27 and the driving connections to the worm gear 19 reversed to retract the boring bar 12 at relatively fast speed and return the cutter head 37 to normal position. During this cut through the cylinder and the return of the cutter head 37 to normal position, the dial 59 and zero point 60 retain their set positions and indicate the depth of the cut being made or just finished.

To make a second cut through the cylinder, the shaft 43 is depressed to couple the same to the pilot 34 and then turned by the hand-piece 32 to further project the cutters 38. If this is to be say a cut of two-thousandths of an inch in addition to the three-thousandths already made, the rotation of the shaft 43 to project the cutters 38 will be stopped when the reading of the dial 59 at the zero point 60 is five one-thousandths of an inch. With the cutters 38 positioned for a second cut the key 30 may be reset for boring speed and thereafter the boring connections to the worm gear 19 started to rotate and feed the cutter head 37.

From the above description, it is evident that after the first cut is made through a cylinder any number of cuts may be made thereafter without re-adjusting the cutters 38 to the wall of the cylinder and the indicator will show the total number of thousandths of an inch cut from the cylinder wall.

During the rotation of the boring bar 12 to project or retract the cutter head 37 by the driving connections to the worm gear 19, the meshing gears 56 and 58 will turn the clutch member 55 at the same speed at which the clutch member 45 is being turned by the shaft 43 and thereby keep the dial 59 and zero point 60 in constant relation.

What we claim is:

1. In a machine of the class described, a tubular boring bar mounted for compound rotary and axial movements and provided with an adjustable cutter, means within the boring bar for adjusting the cutter, a rotatable tubular feed screw held against axial movement and having threaded engagement with the boring bar for feeding the same axially, common means operable, at will, for either rotating the feed screw or for operating the cutter-adjusting means and including a rod extending axially through the feed screw, a normally set clutch connecting the rod to the feed screw and a normally released clutch for connecting the rod to the cutter-adjusting means, operating connections including a friction clutch actuated by the rotary movement of the boring bar for rotating said rod at the same rotary speed as the boring bar, and a differential drive from the driving connections, on the driven side of the friction clutch, to the feed screw for rotating the same at different speeds.

2. In a machine of the class described, a tubular boring bar mounted for compound rotary and axial movements and provided at one end with an adjustable cutter, means within the boring bar for adjusting the cutter, a tubular feed screw extending axially into the boring bar from the other end thereof and having threaded engagement therewith, said feed screw being held against axial movement in respect to the boring bar, means operable, at will, for either rotating the feed screw or for operating the cutter-adjusting means and including a rotatable rod extending axially through the feed screw with freedom for axial movement, a clutch operable during the retracting movement of the rod to connect said rod to the feed screw and a second clutch operable during the projecting movement of the rod to connect said rod to the cutter-adjusting means, a spring normally holding the rod retracted, a friction clutch, the driven member of which is connected to the rod for rotation therewith but with freedom to permit said rod to be moved axially therethrough, driving connections from the boring bar to the driving member of the friction clutch for rotating the rod at the same rotary speed as the boring bar, and a differential drive from the driving connections, on the driven side of the friction clutch, to the feed screw for rotating the same at different speeds.

3. The structure defined in claim 2 which further includes a micrometer scale, one member of which is movable with one member of the friction clutch and the other member of which is movable with the other member of said clutch.

4. In a machine of the class described, a tubular boring bar mounted for compound rotary and axial movements and provided at one end with an adjustable cutter, means within the boring bar for adjusting the cutter, a tubular feed screw extending axially into the boring bar from the other end thereof and having threaded engagement therewith, said feed screw being held against axial movement in respect to the boring bar, means operable, at will, for either rotating the feed screw or for operating the cutter-adjusting means and including a rotatable rod extending axially through the feed screw with freedom for axial movement, a clutch operable during the retracting movement of the rod to connect said rod to the feed screw and a second clutch operable during the projecting movement of the rod to connect said rod to the cutter-adjusting means, a spring normally holding the rod retracted, a friction clutch, the driven member of which is connected to the rod for rotation therewith but with freedom to permit said rod to be moved axially therethrough, driving connections from the boring bar to the driving member of the friction clutch for rotating the rod at the same rotary speed as the boring bar, and a differential drive from the driving connections, on the driven side of the friction clutch, to the feed screw for rotating the same at different speeds, one member of said clutch having an indicator that is circumferentially adjustable thereon.

5. The structure defined in claim 2 which further includes a micrometer scale, one member of which is movable with one member of the friction clutch and the other member of which is a collar mounted on the other member of the friction clutch for circumferential adjustment about the axis thereof.

6. In a machine of the class described, a tubular boring bar mounted for compound rotary and axial movements and provided at one end with an adjustable cutter, means within the boring bar for adjusting the cutter, a tubular feed screw extending axially into the boring bar from the other end thereof and having threaded engagement therewith, said feed screw being held against axial movement in respect to the boring bar, means operable, at will, for either rotating the feed screw or for operating the cutter-adjusting means including a rotatable rod extending axially into the feed screw with freedom for axial movement, a clutch operable during the retracting movement of the rod to connect said rod to the feed screw and a second clutch operable during the projecting movement of the rod to connect said rod to the cutter-adjusting means, a spring normally holding the rod retracted, a friction clutch, the driven member of which is connected to the rod for rotation therewith but with freedom to permit the rod to be moved axially therethrough, driving connections actuated by the rotary movement of the boring bar for rotating the driving member of the clutch at the same rotary speed as the boring bar, said driving connections includes a shaft, gears con-

necting the boring bar to the shaft, a pair of intermeshing gears, one of which is fixed on the shaft and the other of which is fixed to the driving member of the friction clutch and a clutch for connecting the loose gear to the shaft, and a differential drive including a clutch from the shaft to the feed screw.

7. In a machine of the class described, a tubular boring bar mounted for compound rotary and axial movements and provided with an adjustable cutter, means within the boring bar for adjusting the cutter, means for feeding the boring bar axially including a tubular screw in threaded engagement with the interior of the boring bar, connections actuated by the rotary movement of the boring bar for operating the boring bar feeding means, and common means including an actuating rod mounted within the screw and extending into the boring bar and having means for selective operating engagement with the boring bar feeding means and the cutter-adjusting means.

8. The structure defined in claim 7 which further includes means for rotating the common means with the boring bar feeding means, whereby the common means is normally held in a predetermined relation to the cutter-adjusting means.

9. The structure defined in claim 7 which further includes means actuated by said connections for rotating the common means with the boring bar feeding means, whereby the common means is held in a predetermined relation to the cutter-adjusting means.

10. The structure defined in claim 7 which further includes means having a friction clutch actuated by said connections for rotating the common means with the boring bar feeding means, whereby the common means is held in a predetermined relation to the cutter-adjusting means.

11. The structure defined in claim 7 which further includes means having a friction clutch actuated by said connections for rotating the common means with the boring bar feeding means, whereby the common means is held in a predetermined relation to the cutter-adjusting means, and a micrometer scale, one member of which is movable with one member of the friction clutch and the other member of which is movable with the other member of the friction clutch.

12. The structure defined in claim 7 which further includes means having a friction clutch actuated by said connections for rotating the common means with the boring bar feeding means, whereby the common means is held in a predetermined relation to the cutter-adjusting means, and a micrometer scale, one member of which is movable with one member of the friction clutch and the other member of which is movable with the other member of the friction clutch, one member of the micrometer scale being mounted for circumferential adjustment on the respective clutch member.

13. The structure defined in claim 7 in which the common means includes a clutch normally connecting said common means to the boring bar feeding means.

14. The structure defined in claim 7 in which the common means includes a clutch normally connecting said common means to the boring bar feeding means, and a normally released clutch for connecting the common means to the cutter-adjusting means.

15. The structure defined in claim 7 which further includes a clutch in the connections, a second clutch normally connecting the common means to the boring bar feeding means, and a third or normally released clutch for connecting the common means to the cutter-adjusting means.

16. In a machine of the class described, a tubular boring bar mounted for compound rotary and axial movements and provided with an adjustable cutter, means within the boring bar for adjusting the cutter, means for rotating the boring bar, a tubular feed screw for feeding the boring bar axially, connections including a clutch actuated by the rotary movement of the boring bar for operating the boring bar feeding means, means manually operable, at will, for either rotating the feed screw or operating the cutter-adjusting means and including a rotatable rod extending axially through the feed screw with freedom for axial movement, a clutch operable during the retracting movement of the rod for connecting said rod to the feed screw, a second clutch operable during the projecting movement of the rod for connecting said rod to the cutter-adjusting means, a spring normally holding the rod retracted, and means having a friction clutch actuated by said connections for rotating the rod with the feed screw, whereby the rod is held in a predetermined relation to the cutter-adjusting means.

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